

Registered by Australia Post —  
publication No. NBP 0240

Australia's

Top Selling Electronics Magazine

# Electronics Australia

MAY 1986

Aust\* \$2.95

NZ \$3.75

\* UHF  
antenna  
for channel 28

60 watt  
per channel **Amplifier to build**

\* CD-Rom . . . new computer memory

\* All about  
custom ICs

**Bonus 164-page Dick Smith Catalog**

AUST.  
ONLY



# The best DMM in its class just got better.



## The Fluke 80TK. One innovation leads to another.

First there was the 70 Series, which set a new standard for low-cost, high-performance, Fluke-quality multimeters.

And now, another first. The Fluke 80TK K-type Thermocouple Converter. A temperature measurement device that adds instant temperature measurement capabilities to the 70 Series DMMs.

Or any DMM, for that matter.

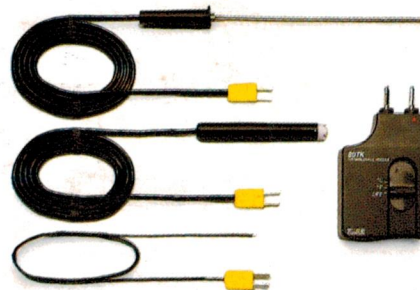
Feature for feature, the versatile 80TK is the most affordable unit of its kind. For quick comparison readings, it can measure °C or °F at the flick of a switch. It includes a built-in battery test. And the availability of 3 Fluke probes give you the flexibility to measure any

form of temperature, from freezer to furnace, with just one base unit.

No other thermocouple converter we know of offers DMM users so much for so little.

So even if you don't own a Fluke 70 Series multimeter, the 80TK will help the DMM you're now using measure up when things get hot. Or cold.

FROM THE WORLD LEADER  
IN DIGITAL MULTIMETERS.



Surface, immersion and general-purpose probes with "mini" thermocouple connectors are available for the Fluke 80TK.

### 80TK SPECIFICATIONS

Temperature Measurement Range
-50 to 1000°C
-58 to 1832 °F
Battery Life: 1600 Hours (9V)

## ELMEASCO

### Instruments Pty. Ltd.

**N.S.W.** 15 McDonald St, Mortlake. Tel: (02) 736 2888  
**VIC.** 12 Maroondah Hwy, Ringwood. Tel: (03) 879 2322  
**QLD.** 243 Milton Rd, Milton. Tel: (07) 369 8688  
**S.A.** 241 Churchill Rd, Prospect. Tel: (08) 344 9000  
**W.A.** 46-48 Kings Pk Rd, West Perth. Tel: (09) 481 1500

Talk to your local distributor about Fluke

• **A.C.T.** Actiec Pty Ltd (062) 80 6576 • **George Brown** 80 4355 • **N.S.W.** Ames Agency 699 4524 • **George Brown** (02) 519 5855 Newcastle 69 6399 • **Bryan Catt Industries** 526 2222 • **Collier Tools** 763 1888 • **D.G.E. Systems** (049) 69 1625 • **Davred Electronics** 267 1385 • **W.F. Dixon** (049) 61 5628 • **Macelec** (042) 29 1455 **Ebson** 707 2111 • **Selectro Parts** 708 3244 • **Geoff Woods** 810 6845 • **N. TERRITORY** Thew & McCann (089) 84 4999  
• **QUEENSLAND** L.E. Boughen 369 1277 • **Colourview Wholesale** 275 3188 • **Fred Hoe & Sons** 277 4311 • **Nortek** (077) 79 8600 • **St Lucia Electronics** 52 7466 • **Selectro Parts (Qld)** 394 2422 • **S. AUSTRALIA** Protronics 212 3111  
• **Trio Electrix** 212 6235 • **Redarc Electronics** 278 7488 • **A.W.M. Wholesale** • **TASMANIA** George Harvey (003) 31 6533, (002) 34 2233 • **VICTORIA** A.W.M. Electrical Wholesale • **Radio Parts** 329 7888 • **G.B. Telespares** 328 3371 • **Browntronic** 419 3986 • **R.K.B. Agency** 82 7704 • **A.J. Ferguson** 347 6688 • **SIRS Sales** (052) 78 1251  
• **Mektronics** 690 4593 • **W. AUSTRALIA** Atkins Carlisle 321 0101 • **Dobbie Instruments** 276 8888 • **Cairns Instrument Services** 325 3144 • **Willis Trading** 470 1118



## THIS MONTH'S COVER

The PC board for our new Playmaster Sixty-Sixty stereo amplifier takes pride of place on this month's front cover. Turn to page 38 for the details.

# Electronics Australia

Volume 48, No. 5

May  
1986

## Features

- 10 STAR WARS *Is it feasible?*
- 28 AN INTRODUCTION TO HIFI PT. 5 *Cartridges and styli*
- 75 SPECIAL FEATURE: CUSTOM ICs *Terminology, types and trends*
- 92 CD ROM *High density computer memory*

## Entertainment Electronics

- 26 HIFI REVIEW *ADC CD-100X compact disc player*

## Projects and Technical

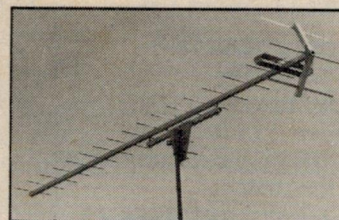
- 18 UHF ANTENNA FOR CHANNEL 28 *Top performance, easy to build*
- 38 PLAYMASTER SIXTY-SIXTY STEREO AMPLIFIER PT.1 *The best yet*
- 51 BUILD YOUR OWN ROBOT PT.3 *Finishing construction*
- 54 CIRCUIT AND DESIGN IDEAS *High performance audio generator*
- 58 THE SERVICEMAN *The case of the mystery chassis*
- 64 COMPRESSOR FOR COMPACT DISCS *For recording CDs onto tape*

## News and Comment

- 4 LETTERS TO THE EDITOR *Don't blow your fuse*
- 5 EDITORIAL *Custom ICs — the way to the future*
- 6 NEWS HIGHLIGHTS *Communications overhaul for Aust. Army*
- 72 FORUM *Utopiatronics: The supplier hobbyists dream about!*
- 108 INFORMATION CENTRE *Answers to reader queries*

## Departments

- 95 CROSSWORD
- 98 BOOK REVIEWS
- 100 NEW PRODUCTS
- 105 COMING NEXT MONTH
- 112 MARKETPLACE
- 113 50 AND 25 YEARS AGO
- 110 NOTES AND ERRATA



### UHF antenna for Channel 28

Looking for a UHF antenna for Channel 28! Save money by building this high-performance 18-element design. Construction begins on page 18.

### What's coming

Next month we intend to publish the circuit details of our new Playmaster Sixty-Sixty Stereo Amplifier and describe a lamp saver project. See page 105 for further details.



### Compressor for compact discs

Want to record compact discs for use in your car cassette player but stymied by excessive dynamic range? This easy-to-build stereo compressor is the answer. See page 64.

### Special notice

Lack of space has forced us to postpone the introduction of our compact disc reviews. For the same reason, Pt.8 of the "Practical Electronics" series has been held over until next month.



**EDITOR**

Leo Simpson, B.Bus. (NSWIT)

**ASSISTANT EDITOR**

Greg Swain, B.Sc. (Hons. Sydney)

**EDITORIAL CONSULTANT**Neville Williams,  
F.I.R.E.E (Aust.) (VK2XV)**TECHNICAL STAFF**

John Clarke, B.E. (Elect. NSWIT)

Colin Dawson

Robert Flynn

Louise Upton, B.A. (Hons. Sydney)

**ART DIRECTOR**

Brian Jones

**ART PRODUCTION**

Alana Horak

**SECRETARIAL**

Carmel Triulcio

**ADVERTISING PRODUCTION**

Brett Baker

**ADVERTISING MANAGER**

Selwyn Sayers

**PUBLISHER**

Michael Hannan

**HEAD OFFICE**140 Joynton Avenue (PO Box 227),  
Waterloo, NSW 2017. Phone: (02) 663 9999.  
Telex: AA74488. Facsimile: 662 1007.  
Representative: Norman Palmer.**INTERSTATE****ADVERTISING OFFICES****Melbourne:** 23rd Floor, 150 Lonsdale Street,  
Melbourne, Vic 3000. Phone: (03) 662 1222.  
Representative: John Oliver, B.A. (Hons.  
Essex).**Adelaide:** John Fairfax & Sons Ltd, 101  
Weymouth Street, Adelaide 5000. Phone:  
(08) 212 1212.

Representative: Dane Hanson.

**Brisbane:** 26 Chermiside Street, Newstead,  
Qld 4006. Phone: (07) 854 1119.  
Representative: Bernie Summers.**Perth:** Tony Allen and Associates, 7 Fore  
Street, Perth, WA 6000. Phone: (09)  
748 9833.

Representative: Jim Wells.

**New Zealand:** 3rd Floor,  
Communications House, 12 Heather  
Street, Parnell, Auckland, New  
Zealand. PO Box 37-291. Telex:  
NZ63122, Telephone: 79 6648.  
Representative: John Easton**ELECTRONICS AUSTRALIA** is published  
monthly by the Federal Publishing Company  
Pty Limited, under licence from Double Bay  
Newspapers Pty Limited, General  
Newspapers Pty Limited and Suburban  
Publications Pty Limited.Typeset and printed by Eastern Suburbs  
Newspapers, Joynton Avenue, Waterloo,  
NSW, for The Federal Publishing Company  
Pty Ltd.Distributed by Gordon and Gotch Limited,  
Sydney.Registered by Australia Post — publication  
No. NBP0240. ISSN 0313-0150.©Double Bay Newspapers Pty Limited,  
General Newspapers Pty Limited and  
Suburban Publications Pty Limited  
(trading as "Eastern Suburbs  
Newspapers"), 1985.\*Recommended and maximum Australian  
retail price only.

# Letters to the editor

## 2CH is south of Charters Towers

I bring to your attention a misprint in the last edition of *Electronics Australia*.

You have listed 2CH (1170kHz) as a stereo AM station, power 0.1kW and located at Charters Towers.

2CH is on 1170kHz and is a stereo AM commercial station. However, our aerial power is actually 5kW and we are located approximately 1630km south south east of Charters Towers in Sydney.

I commend you for the stereo AM article. Keep up the good work.

**Alan Liddelow,**  
**Network Chief Engineer,**  
**Radio Station 2CH,**  
**Sydney, NSW.**

## Don't blow your fuse

On page 89 of the March edition of EA, in an article entitled "What to do

when the fuse blows," there is a most incongruous statement. Surely your author must have shares in a fuse factory.

He advises the reader to buy two 100mA fuses and to blow them by connecting them directly across a battery. Now, really!

The poor reader already has a handful of blown fuses — this is the very fault he is trying to cure — and your writer asks him to blow two more! Hells Bells!

Whatever is wrong with your reader using two of his already blown fuses to make the test rigs being suggested by the writer? Why add to the slaughter by blowing two more?

In fact, it often pays to keep a small selection of blown fuses, shorted transistors, u/s integrated circuits and other small mechanical parts. These come in useful for test rigs as mentioned in the above article or as templates when cutting or drilling chassis panels.

But for heaven's sake, don't buy new fuses and blow them deliberately.

**Jim Lawler,**  
**Geilston Bay, Tasmania.**

## Intelsat reception in Australia

We read with interest Mr Garry Crapp's letter in your November issue regarding the satellite television scenario across the Tasman. We were even more interested in the reply from your Department of Communications in the January issue.

Whilst not being in a position to comment categorically on reception, either domestic or international in Australia, we can certainly point out a few minor facts about footprints from our experiences in New Zealand.

It is true that the aging Intelsat IV A died on Tuesday, 4 February, 1986, at 11 pm New Zealand time. An Intelsat V was moved from the Indian Ocean at 53°W to the 180°E spot to fill the role of Pacific operational spare. The results to date in New Zealand have been very encouraging as signal quality has improved on all 30 of our 7-metre dishes

which we have shifted 1°.

The comment regarding beams not being receivable in Australia from Intelsat V appears incorrect as both west hemispheric and global beams should be receivable. The west hemispheric beam covers an area up to Fiji and the global beam covers the entire Pacific basin. Obviously such signals will only be resolvable on dishes of larger than five metres diameter with appropriately modified receivers but they are there for anyone who wishes to receive them.

Our information indicates that there are over a dozen satellites with footprints to many different parts of Australia. These consist of high power spot beams, medium power hemispheric beams, and low power global beams, which should be able to be resolved using a 7-metre parabolic dish antenna, 55°K LNA, and receiver with an international bandwidth filter.

**Tony Dunnett,**  
**Technical Co-ordinator,**  
**Motueka, NZ.**



## Teletext in South Australia

Your article "Forum" in last month's issue of *Electronics Australia* quite rightly poses the question "Do we have Teletext or not?" when based on the correspondence between the ABC and a viewer at Quorn in South Australia.

Regrettably, our reply to the viewer's Teletext enquiry, which you reprinted in your article, not only contained some outdated information but also arose from some degree of confusion in respect of the specific Teletext facility (Supertext) as distinct from the general Teletext services.

Please allow us to set the record straight.

In South Australia, the ABC has been transmitting the Supertext Subtitling Service for the Hearing Impaired since 4th November, 1984. It was introduced with appropriate media references at that time.

As your article correctly states, only selected programs are captioned and carry the symbol 'S'.

In January the following year, we began transmission of four test pages as part of the Teletext Information Services. The expansion of this service is currently under review in our head office.

We apologise for compounding any confusion and have informed the viewer accordingly.

**John Geyer,**  
Manager Television,  
Australian Broadcasting Corporation,  
Adelaide, SA.

## Not everyone benefits

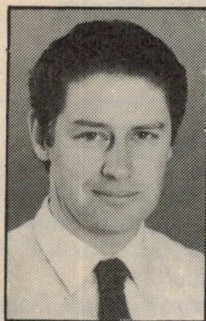
I have finished reading your article on the wonderful new world of AM stereo enjoyed by a few lucky Australians.

It seems strange to me that while broadcasting in some areas of this country races ahead at a great pace, in other areas it has changed very little in the last 50 years.

Here in Burnie we have only one commercial AM station broadcasting narrow band mono, and the only FM station is an ABC FM transmitter 100km away.

I feel it is the responsibility of the Department of Communications and the Australian Broadcasting Tribunal to ensure that all Australians enjoy the benefits of new broadcasting technology and not just those in metropolitan Australia.

**Clinton Hodgetts,**  
Burnie, Tas.



## Editorial Viewpoint

### *Custom ICs: the way of the future*

This month we have made a big effort to bring you a feature story on one of the most potentially far-reaching developments in electronics since the introduction of the microprocessor. I refer to custom ICs. The story starts on page 75. Whether you have previously heard or seen reference to them as gate arrays, programmable logic arrays, uncommitted arrays or whatever, they represent one of the biggest opportunities that Australia has to compete with electronic products in the world market.

The problem for Australian manufacturers is that the home market is not really big enough to enjoy large economies of scale yet we still demand the latest technology. That means that any manufacturer developing new products must try to incorporate the latest technology without being committed to large development costs. At the same time, once the product is developed, the manufacturer needs to be sure that he will have a market advantage for a sufficient time to make a good profit.

In other words, he wants to be sure that the product won't be copied almost as soon as it reaches the market. And having designed the product for the local market, he ideally then wants to be able to sell it overseas and be able to make much bigger profits.

This is where custom ICs come into their own. They enable exclusive design features to be economically incorporated into an encapsulated chip. Depending on the type of IC and volume of production, the cost of this can be quite low and the development time quite short. So an up-to-date product with special features can be brought to market quite quickly. And once on the market, the product is much harder to copy than if it used standard off-the-shelf ICs.

Given that Australians have generally been quite innovative in developing new products (although not necessarily so effective in marketing them), the use of custom ICs will enable us to protect that innovative advantage.

Combined with the advantages of surface-mount components, custom ICs could well be the path of success for Australia's electronic industry in the future. One thing is sure: if Australian industry is slow to adopt the technology of custom ICs and surface-mount components it cannot hope to succeed on world markets.

(We last covered the emerging field of surface mount devices in July 1985. We plan to have another feature article on this subject in the coming July issue.)

**Leo Simpson**



# News Highlights

## West Germans to computerise ID cards

While debate on Australia's proposed ID card system waxes fast and furious, the West German government has passed a bill making that country's existing ID card and passport system computer-readable. Germans will be required to carry the new cards from the middle of next year.

The move has inspired mixed reactions among West German citizens. Some see it as ushering in a police state, while others view it as a necessary step in the fight against internal and external terrorism and political dissent.

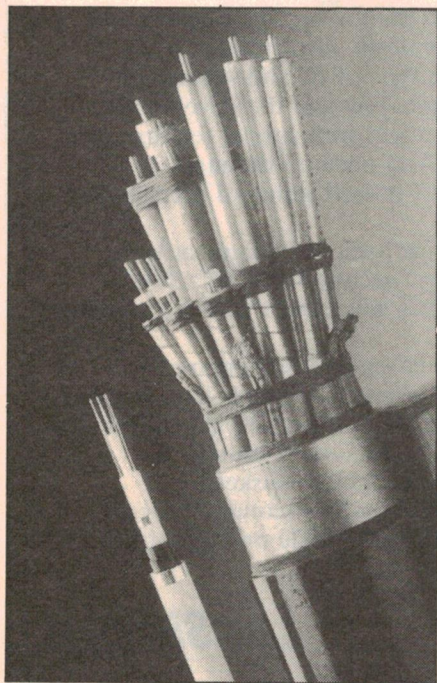
The new cards will allow authorities to store data on an individual's movements in central computers. This data will be made available to all law enforcement agencies, ranging from traffic wardens to the state intelligence agency and border police.

Seven data-protection laws were enacted to go with the new bill on ID cards. These are meant to ensure that the information is not misused by the security authorities. However, opponents of the system see it as yet another state infringement of the citizen's right to "informational self-determination".

## Optical fibre factory opened

Australia's first commercial optical fibre manufacturing plant was recently opened in Melbourne by the Victorian Premier, John Cain.

The \$12 million plant with a capacity to produce 50,000km of optical fibres annually has been built by Optix Australia Limited, an international joint venture with three partners: Pacific Dunlop Limited, Sumitomo Electric Industries of Japan and Pirelli Cables Australia.



The technology employed at the plant was developed by Sumitomo Electric and is accepted as being of world standard. Both Pirelli Cables and Olex Cables purchase the bulk of the output of the Optix plant for fabrication of optical fibre cords and cables in their own factories.

The fibre consists of a core of optically transparent material surrounded by a cladding with a refractive index slightly smaller than that of the core. Compared with traditional copper cable, an optical fibre cable has considerably greater transmission capacity in a physically smaller cable and can be manufactured in longer lengths, thus eliminating costly joining and manual handling.

In addition, optical fibre cables are not subject to electrical interference, offer greater flexibility, and have higher stress and temperature tolerances than coaxial cable.

Optical fibre cables are already being installed in Australian communications networks. For example, Telecom Australia has begun installation of an 8-fibre optical link in the Northern Territory and, in January of this year, began work on the Melbourne-Sydney optical fibre link.

The latter has a planned route of approximately 1000km, will contain 30 single mode optical fibres, and will cost around \$44 million. It will be capable of carrying 150,000 simultaneous telephone channels and will be used for data and video transmission.

## SBS-TV goes west and south

SBS-TV has recently expanded its activities and is now available on UHF channel 28 in both Hobart and Perth. According to an SBS press release, programs originate from Sydney and are relayed via Aussat to transmitters atop Mt Wellington (Hobart) and Mt Bickley (Perth).

To pick up UHF TV, viewers can either use a TV set with a built-in UHF tuner or use a VCR as a downconverter. In the latter case, the UHF signal is simply tuned in on the VCR and the output from the VCR fed to the TV set (usually on either channel 0 or channel 1).

The third approach is to build the UHF Converter described in *Electronics Australia*, April 1986. This can be purchased in kit form from several electronics retailers (see advertisements this issue).

A Band IV antenna suitable for channel 28 will also be necessary in most cases (see *Electronics Australia*, December 1985). This can be either a commercial design, or you can build the high-performance design described elsewhere in this issue.

## CD sales soar — digital tape next?

With compact disc players now a mass-market item, a number of Japanese manufacturers are gearing up for the introduction of digital audio tape (DAT) records.

First cab of the rank is Onkyo Corp., which surprised industry observers by showing a prototype DAT recorder at the Winter Consumer Electronics Show held last January in Las Vegas, USA.

Known as the DT-1000, the Onkyo machine is the first of its ilk to make an appearance at the CES, though Sony and others have quietly shown prototypes in Japan. According to Onkyo, the unit is slated for introduction in the US early next year with an estimated price tag of \$1000.

The DT-1000 is based on the rotary head (R-DAT) format, one of two standards formalised last year by a committee of 81 member companies. It uses a cassette measuring just 73 x 55 x 10mm, slightly smaller than a conventional audio cassette.

Because of the compact size of the cassette, Onkyo believes that DAT players will have a big impact on CD in-car sound.



## Australian company to make compact discs

A small Adelaide company, Pro-Image Studios Ltd, has scored a major industry coup by securing the rights to build Australia's first compact disc factory.

Pro-Image, which produces television programs in Adelaide and Melbourne, has beaten some high-powered opposition to win the first Australian manufacturing licence from the patent holder, the Philips electronics group.

Pro-Image has proposed building a \$15 million plant with a production capacity of five million compact discs per year. The growth in CD sales in Australia has been so rapid that directors believe the plant will operate at capacity virtually from start-up.

It has yet to be decided where the highly automated plant will be located. According to the company, the factory will be made larger than necessary to allow room for expansion into video discs at a later date.

Once underway, the project should benefit from the rapid expansion in demand for compact discs. World production of disc players increased from 770,000 in 1984 to four million during 1985, while estimates for 1986 exceed 10 million.

## Want to buy a hot PC?

Personal computers are going the way of video cassette recorders — they have become a target for thieves.

It is believed that organised groups are gaining access to lists of computer owners, stealing their equipment and then selling it through classified advertisements in newspapers.

High on the risk category are those who own IBM PCs and compatibles. One victim who recently lost two IBM PCs from his office has now set up a "PC Theft Database" to help police stop the rise in burglaries. PC Theft Database can be contacted by calling Steve Townsend on (02) 81 3070.

## Subscription Prize Winner

The winner of the January 1986 special subscription offer is Mr K. Koschel of East Ringwood, Victoria. Mr Koschel's prize is a Sharp DX-110 compact disc player.



## Communications overhaul for Australian Army

Contracts valued at \$575 million have recently been awarded to the Australian telecommunications industry to take the army's communications networks into the 21st century.

The main aim of the program is to replace analog communication systems — some of which have been in service for almost 20 years — with state-of-the-art digital equipment. One of the many advantages of a digital network is that signals are much easier to encode, thus ensuring security.

Three major and distinctly different areas of communication will be updated. These are code named DISCON, RAVEN and PARAKEET.

Project DISCON (Defence Integrated Secure Communications Network) is the nearest to completion. Managed by Plessey Australia Pty Ltd, it is a \$200 million fully integrated digital secure telephone, telegraph, facsimile and data network linking Australia's permanent military bases.

In its final form, DISCON will link with RAVEN, a tactical system employing manpack radios, and PARAKEET the tactical defence communications network which uses vehicular transport.

The RAVEN family consists of a manpack HF transceiver, a manpack VHF

transceiver, RF power amplifiers, headsets, message entry devices, power cables and other ancillary equipment.

A number of local sub-contractors are involved in this section of the project and they include Scalar Industries, LJ Wallace, Tubemakers of Australia, Antenna Engineering Australia, Hallmark International New Zealand and Computer Sciences Australia. Additional sub-contractors will be added as the project develops.

Project PARAKEET, which is managed by Racal Electronics, is aimed at the communications system needed above the immediate combat level. The existing network consists of an array of terminal switching systems, control and transmission equipment, and various stop-gap items of equipment.

This will be replaced with an all digital secure multi-mode (voice, data, facsimile, telegraph) system. The total cost of project PARAKEET exceeds \$225 million alone.

A major difference between PARAKEET and overseas systems is the degree of integration of HF bearers. Although satellite links will play an important role in PARAKEET, the Army believes that, given Australia's unique terrain, HF is indispensable.



# New act gives RIs greater clout

Department of Communications' radio inspectors have recently hunted down and prosecuted a number of illegal users of the airwaves.

In one unusual case, an unlicensed radio operator, who identified himself as "the original wombat", was driving a locomotive around Sydney railway yards late at night, transmitting obscenities.

Stopping his illegal activities was all in a night's work for Department of Communications' radio inspectors. The story ended in court where the wombat had \$300 worth of equipment confiscated and was fined \$200 plus \$28 costs.

In another case recently, a Queensland man made repeated calls to emergency services on marine distress channels, claiming he was on a boat with several other people outside the Southport sandbar. The condition of the bar at the time was dangerous. Although he didn't say his boat was in trouble, his continued requests for information about the bar, and his failure to ac-

knowledge repeated warnings, alarmed rescue services.

The man was, in fact, transmitting from home. As well as losing his equipment, he was fined \$300 plus \$30 costs.

Both these cases were prosecuted under the old Wireless and Telegraphy Act 1905. Late last year, the new Radiocommunications Act came into force. Penalties under the new act are much more severe, as another Queensland man found out. He made hoax calls to the Cairns coastguard and was fined \$2500 and had a \$150 marine transceiver and a \$200 CB transceiver confiscated.

In recent cases involving unlicensed operators of CB equipment, the minimum fine imposed by the courts has been \$400 but fines up to \$750 are common. And, under the new Act, the Department not only expects more prosecutions, but is planning on introducing on-the-spot fines similar to those given out for traffic offences.

## Flat-screen TV displays

A joint research project in Britain is working on an interesting new approach to flat-screen displays for computers and television sets.

Tech-Nel Data, which funds the work, and the Department of Electrical Engineering at the Imperial College of Science and Technology in London have developed a small working prototype which they intend scaling up with the help of further outside investment.

The screen is made from a parallel grid of optical fibres, each of which takes light from a source at one edge of the screen and carries it across to the other edge. The fibres themselves are covered with a liquid-crystal. The light normally remains trapped inside the fibres but if the optical characteristic of the LCD material is changed at any position along the fibre, the light pours out and is visible as a bright dot.

A perpendicular grid of thin wire electrodes is used to control these changes in the LCD's characteristics. By controlling the strength of the light from the edge sources and the leakage pattern, an image can be created on the screen.

Colour images can be created by transmitting red, green and blue light down alternative fibres.

# Moonwriter aids blind



Developed by three British schoolboys, the Moonwriter is a device which enables blind people to read and write letters, telephone numbers, labels and other messages. The device is now available commercially.

Moon is a simple language based on nine uncomplicated embossed characters and invented by Dr Moon in 1847. Before the machine was developed, the language was produced as reading material only at the Royal National Institute for the Blind's (RNIB) printworks.

Greatly enhancing blind people's capacity to communicate, the system is particularly suited to those who lose their sight in later life and whose finger touch is not so sensitive. It is also easier to learn than Braille and can be read by sighted relatives and friends of the blind.

Manufactured in conjunction with the RNIB by Possum Controls Ltd, the Moonwriter is easily adaptable to most languages based on the Roman alphabet.



# SIEMENS

## VARISTORS

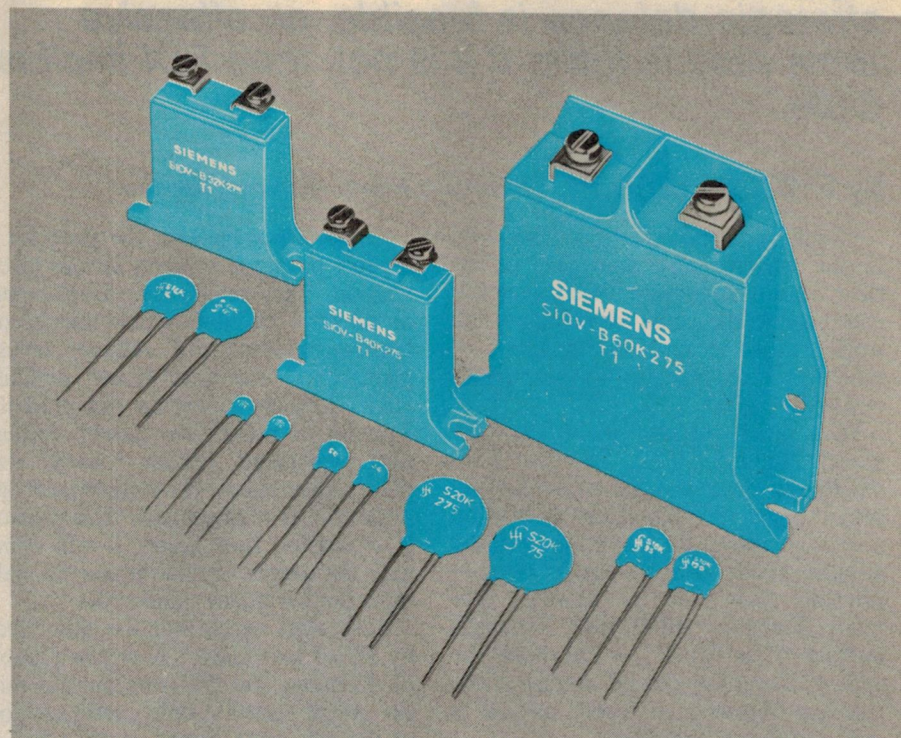
**Australia's widest range.  
All applications. Biggest stocks.  
Lowest prices. Quickest delivery.  
What else?**

Siemens is now the biggest and best source of varistors in Australia with a full size range for all applications up to 70 kA. This is of special interest to the telecommunications industry. Comprehensive stocks, plus Siemens position as one of the world's largest manufacturers of varistors underwrites our promise of quick delivery and suitability.

Siemens innovation aims at achieving substantial cost reductions across a wide spectrum in the following applications:

- ☐ Power engineering
- ☐ Electronic communications
- ☐ Power electronics
- ☐ Measuring technique
- ☐ Processing technique
- ☐ Office electronics
- ☐ RFI suppression
- ☐ Stepped protection

This wide range of varistors is available through Siemens newly strengthened national distributor network. For further information, post the coupon or phone your nearest distributor.



### Distributors

Victoria: Promark Electronics (Vic)  
(03) 878 1255

New South Wales: Nexus Electronics Pty Ltd  
(02) 439 5800

New South Wales: Promark Electronics Pty Ltd  
(02) 439 6477

Queensland: ECQ Electronics  
(07) 376 5677

South Australia: R.G. Pank Pty Ltd  
(08) 51 2411

South Australia: Protronics Pty Ltd  
(08) 212 3111

Western Australia: Reserve Electronics  
(09) 328 9755

New Zealand: Delphi Industries Ltd  
Auckland 563 259

Please mail me the new informative varistors brochure.

NAME .....

TITLE .....

COMPANY .....

ADDRESS .....

STATE..... POSTCODE.....

Post this coupon now to Siemens Ltd.  
Advertising Department, Melbourne.  
544 Church St., Richmond 3121.

### Siemens Ltd.

544 Church St., Richmond, Vic.

Melbourne: 420 7318 Sydney: 436 8730

Brisbane: 369 9666 Perth: 362 0123

## INGENIOUS ELECTRONIC ENGINEERING



# STAR WARS!

## ... is it feasible?

*President Reagan's Strategic Defence Initiative — dubbed "Star Wars" — has triggered furious debate among scientists. If strategic defence is feasible, an offensive arms race is futile; if it is not, then SDI itself is futile.*

by **ERIC J. LERNER\*** *Electronics Editor, Aerospace America.*

"I call upon the scientific community in our country, those who gave us nuclear weapons, to turn their great talents now to the cause of mankind and world peace, to give us the means of rendering these nuclear weapons impotent and obsolete."

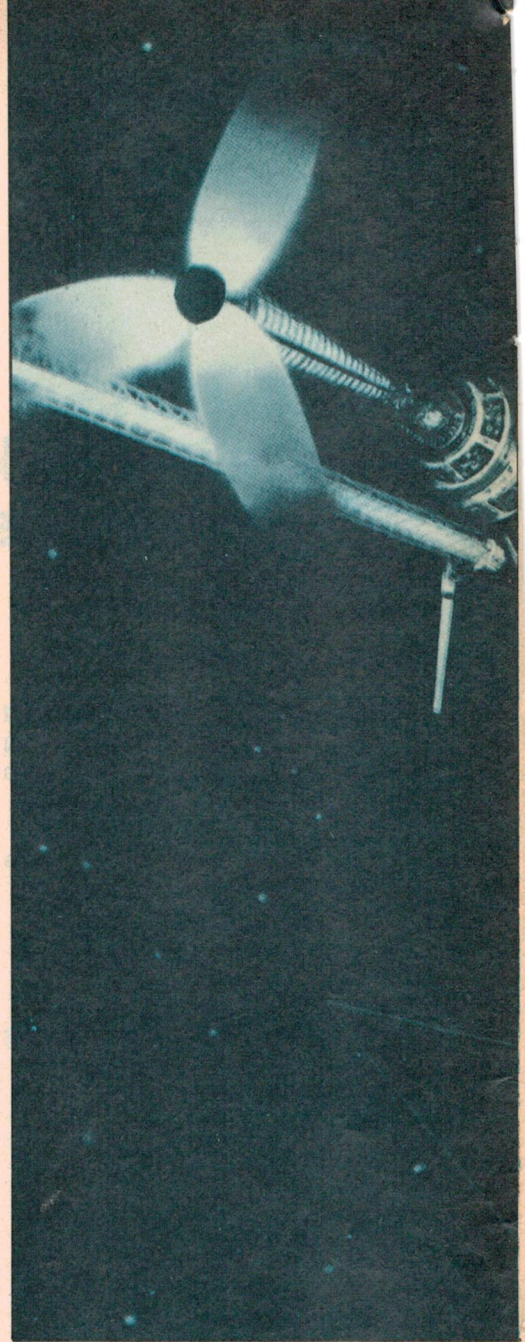
With these words, in a televised speech March 23, 1983, President Ronald Reagan launched the ambitious and controversial research effort to develop a defence against nuclear-armed ballistic missiles. From the start, the program — officially known as the Strategic Defense Initiative (SDI) and popularly dubbed "Star Wars" — has been the centre of intense debate among scientists and arms-control experts as well as in Congress and the press.

SDI critics, among them many scientists who have been or still are deeply immersed in weapons development, contend that the program is unachievable, that there is no way to defend the US (or any other country) from missile-borne nuclear weapons, nor can these weapons be rendered "impotent and obsolete". Critics also warn that the effort to develop these defences could sabotage any chances for arms control and for a reduction in the numbers of nuclear weapons. They fear that deploying space-based defences could lead to confrontation, even war, or at best to an exhausting and costly arms race between offence and defence.

Supporters argue that the program is feasible or that it warrants serious investigation. They reason that development of effective defences would render offensive missiles poor military investments, and therefore would diminish Soviet military expansion and prod the Kremlin to reduce its nuclear arsenal. SDI proponents further contend that the defence effort will complement and assist, rather than subvert, arms control. If successful, they argue, it will eliminate the danger of nuclear war by making a nuclear attack impossible.

Both sides agree that the task faced by SDI is formidable. A system capable of defending the US from nuclear missile attack must not only eliminate most of the attacker's forces, it must be invulnerable. It must also contribute to nuclear stability, when deployed, by allowing no advantage to a first strike. Lastly, it must be cost-effective, that is, it must cost the attacker much more to overwhelm a given defence than the defence costs to build.

The main obstacles to the realisation of the SDI program are the immense destructive power of nuclear weapons and the large number of such weapons already deployed. A single one-megaton nuclear warhead — a typical size in the Soviet arsenal — delivered on a US metropolitan area would kill one or two-million people. According to the US Arms Control and Disarmament

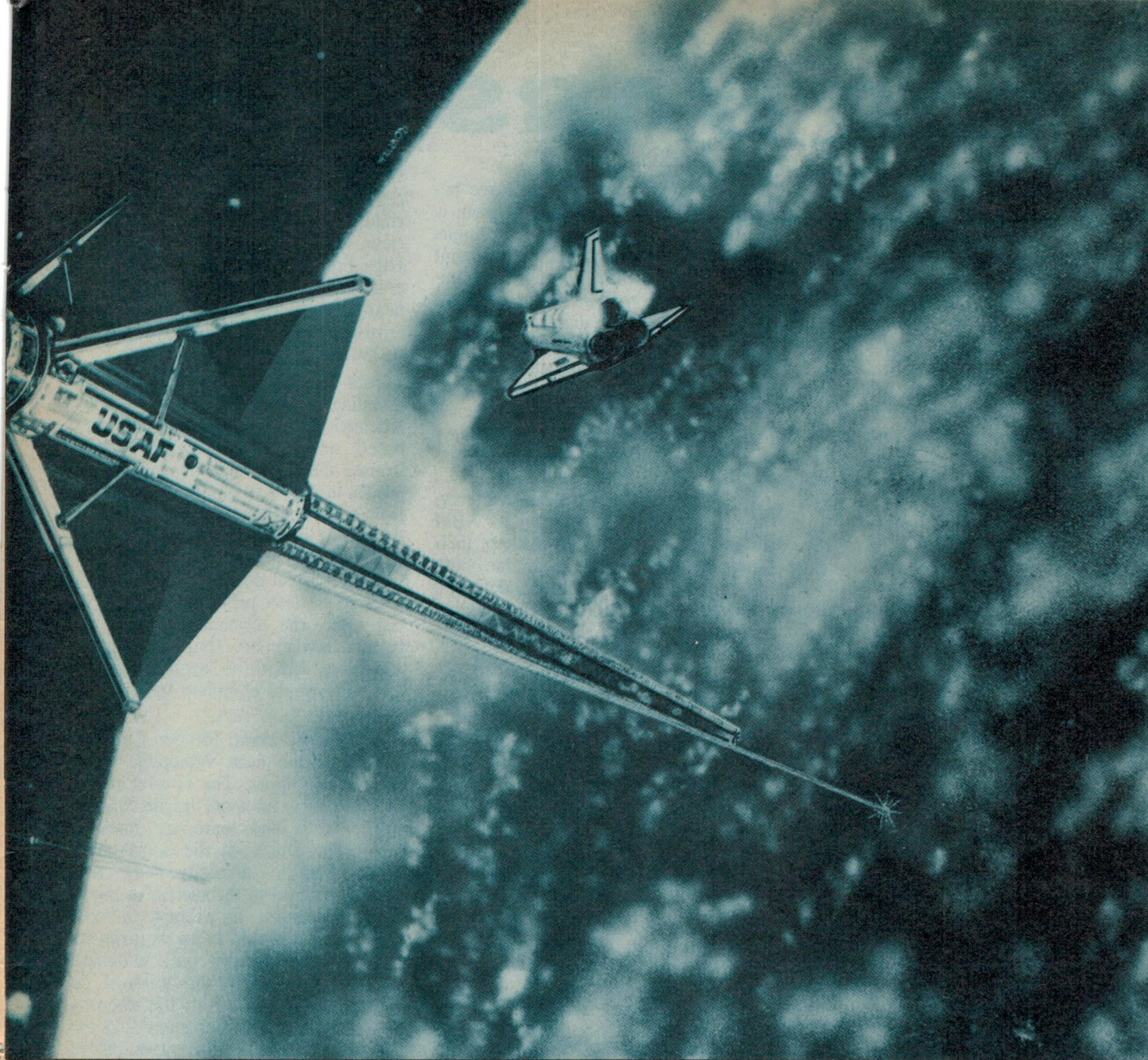


Agency, as few as a dozen such weapons detonated over major US cities would bring death or severe injury to over 20-million people. One hundred of them would wipe out US society.

The Soviet Union has over 5,000 one-megaton warheads, over 250 warheads yielding between 15 and 20 megatons, and a couple of thousand sub-megaton warheads. A US defence would have to knock down 99.99% of the incoming missiles to be "leak proof". To reduce the threat of annihilation of the US population would call for between 99.5 and 99.7% effectiveness, allowing penetration of no more than 25-50 warheads.

Adding to the difficulty is the very nature of intercontinental ballistic missiles (ICBM) or sub-launched ballistic missiles (SLBM) that deliver these weap-





ons. ICBMs travel at about 7-8 km/sec and complete their journey in some 30 minutes. Some SLBMs can complete their mission in five minutes. Each of the ICBM's three-part trajectory — boost phase, mid-course, and terminal phase — poses special defence problems. During boost phase, while the rocket is still firing, the missile is most vulnerable. Yet, for at least part of this phase, it is protected against some weapons by the atmosphere itself. This protection also exists during the terminal phase as the warhead-laden re-entry vehicle returns to the atmosphere. In its mid-course phase, the re-entry vehicle can be protected by swarms of decoys.

An effective defence must thwart not only current threats but prepare for future ones, as the Soviets might develop

weapons designed to negate any new US defence system. Since the A-bomb, the arms race has been characterised by one-up-manship on either side, first with the development of the H-bomb, ICBM, and multiple independent re-entry vehicle missile (MIRV) by the

***“An effective defence must thwart not only current threats but prepare for future ones.”***

US, and subsequent development of similar weapons by the Soviets. To negate this effect, SDI must rely on a system that can unequivocally defeat countermeasures that may use the same technology as the defence.

The current debate over strategic defence is the second such controversy in the history of nuclear weapons. The first round, deployment of the Sentinel/Safeguard system in the late '60s and early '70s set the stage for and raised many of the issues still under discussion.

In 1967, the Johnson administration decided to build a ballistic missile defence — or antiballistic missile (ABM) — system to protect American cities from attack. The system was to use two layers of nuclear-armed missiles, Sentinel to intercept warheads outside the atmosphere and Sprint to destroy those slipping through the first layer. Both were to be guided by ground-based radar. At the same time, the Soviets began to deploy a similar ABM system — Galosh — around Moscow.



# STAR WARS

Sentinel sparked an immediate and intense dispute. Critics argued that it could not work as it would be saturated by an overwhelming attack and that its sensors were a very soft target, highly vulnerable to any stray warhead. In addition, critics warned that, in a crisis, the system could tempt both the Soviets and the US to exercise a first strike. Since Sentinel could handle a disorganised retaliatory strike far more capably than a coherent and massive first strike, both the US and USSR might reason that if a war seemed inevitable, a first strike would greatly reduce the damage the attacking nation might sustain.

In an effort to penetrate Soviet defences, the US came up with a simple but effective countermeasure: MIRV. By allowing a single missile to saturate the defence with 10 or more warheads, MIRVing effectively undermined the Sentinel-Galosh-type defence. In addition, no reliable means of sorting out re-entry vehicles (RVs) from decoys outside the atmosphere was ever devised.

In 1969, faced with the discouraging prospect that Sentinel could never really protect US cities and owing to mounting popular opposition to basing nuclear-tipped rockets near populated centres, the Nixon administration backed away from the concept, reoriented Sentinel to the defence of missile silos, and rechristened it Safeguard.

In 1972, the Soviet Union and the US agreed to curtail sharply development of ABMs by signing the ABM Treaty in conjunction with limits on offensive missiles agreed to in the SALT I round of talks. Initially, the treaty limited both sides to two, and later one defence site (Moscow, in the case of the Soviets, and a Minuteman base for the US).

The ABM Treaty, currently the only

arms limitation agreement in force between the US and the Soviet Union, is of unlimited duration and prohibits development, testing, and deployment of any ABM of the type now contemplated by SDI. All mobile systems — air-, sea-, and space-based — and all systems using technologies other than rockets are permanently banned. It can be revised by mutual consent once every five years. The treaty allows each party to withdraw when "extraordinary events have jeopardised its supreme interests."

In the aftermath of the ABM Treaty, the US eventually dismantled its ABM site in 1975, while the Soviets kept their Moscow system. In the meantime, both the Soviets and the US deployed MIRVed missiles. Result: The number of warheads on each side approximately quadrupled during the '70s.

The issue of strategic defence lay dormant during the rest of the '70s while

***"I do not look forward to having our satellites, their mines, our countermines and so on, all floating around in the same place."***

the Nixon, Ford, and Carter administrations focused on controlling the expansion of offensive arms. This effort ended in failure when the US did not ratify the SALT II agreements. The Reagan administration, sceptical at first of the prospects for arms agreements, turned out to offer a more fertile ground for cultivating the strategic defence approach.

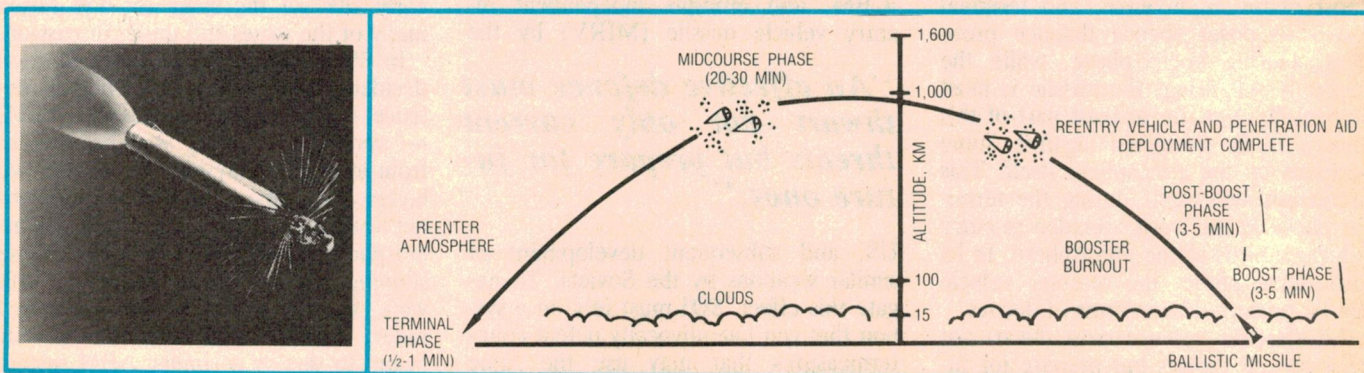
Soon after taking office, Reagan was briefed on strategic defence by two

groups of proponents. One, based at Lawrence Livermore Lab and led by Edward Teller, urged the President to launch a broad research program to investigate advanced missile defence concepts, especially Livermore's own brainchild, an X-ray laser energised by a nuclear weapon. A second group, called High Frontier, and led by former General Daniel Graham, advocated the near-term deployment in space of a defensive system that would use current rocket technology.

Both concepts, and others then being investigated by the Defence Advanced Research Projects Agency that were based on lasers or intense particle beams, differed from the Sentinel approach in that they emphasised defences from space that could neutralise missiles during the boost and mid-course phases of flight. The idea of a three-tiered defence would cut down the need for each layer to be leak proof and prevent the last layer, the terminal defence, from being overwhelmed. Thus, for example, a defence with three layers, each 90% effective, would eliminate 99.9% of all warheads.

Equally important, the boost phase is considered the most vulnerable leg of the missile's flight. The booster is easy to spot and is far more fragile than the smaller RVs and there are fewer of them. The attack on the boost phase, which must by necessity come from space, is critical to the success of the remaining layers. If, for example, a boost-phase layer designed to knock down 900 out of 1,000 missiles only eliminates 800, the mid-course and terminal defences will be faced with the awesome task of handling twice as many RVs and decoys as planned, and the terminal defence 10 times as many.

In his speech in March 1983, President Reagan ordered development of such a multi-layered defence. Adopted and now being carried out by the SDI Office, the plan includes a broad-based



Left: the US Army's experimental anti-missile missile. Right: SDI would stop missiles during the boost and mid-course phases of flight.



program of research and development into all non-nuclear defence systems. The nuclear-based X-ray laser is funded through the Dept. of Energy, as is other research on nuclear weapons.

Funded last year at \$1.4 billion and with \$3.7 billion requested for 1986, the program represents the largest current defence research effort. If it grows at the pace outlined by the administration, it will rapidly become the largest military program since the Manhattan Project.

The research now included in SDI did not originate with the president's speech. Instead the defence initiative centralises research already ongoing in various DOD programs, and greatly increases their funding for fiscal years after 1985.

SDI and the Dept. of Energy nuclear weapons program aim at developing a wide panoply of defensive systems. These weapons fall into three categories. The most exotic and most publicised are the directed-energy weapons — lasers and beams of accelerated particles (protons, electrons, or hydrogen atoms) — that could strike against missiles at the speed of light or close to it!

The second group consists of kinetic-energy weapons, a fancy name for projectiles that would have to ram the missile head-on to kill it, and could be accelerated either by conventional rockets launched from space platforms or by much newer devices that fire the projectiles electromagnetically.

The third type of weapon is the X-ray laser, which is based on submarines and popped up on rockets into the vicinity of opposing ICBMs whose launch has been detected. The program is conceived of as a research effort leading to later development programs, with deployment of weapons, if any prove feasible and desirable, sometime in the 1990s or later.

As with Sentinel, SDI has been greeted with intense criticism, both from US scientists and from the Soviet Union. Leading American critics, including IBM's Richard Garwin, Hans Bethe of Cornell Univ., Sidney Drell of Stanford, and Ashton Carter of MIT (Massachusetts Institute of Technology), contend that SDI goals are unreachable and that the mere effort to pursue them will put an end to arms control, speed up the arms race, and possibly provoke a war.

Key technical issues hinge on feasibility. "There are three reasons why space based defences can't work," Garwin asserts. "Such defences are too easily defeated by countermeasures, too vulner-



One countermeasure to SDI would be the fast-burn ICBM. The technology already exists.

able, and hence too costly."

Critics claim that countermeasures such as fast-burn boosters greatly reduce the time boost-phase defences have to operate and increase the attacker's ability to use the atmosphere for protection. Millions of decoys can further weaken and defeat US defences. "We have to remember that this project is not working against nature, as other research programs do, but against a determined opponent who will try to thwart anything we do," Garwin points out.

They are too vulnerable, says Garwin,

because those based in space in peacetime (except the pop-up X-ray) can be targeted by systems as simple as space mines — bombs floating close to the stations — ready to explode on command. US X-ray lasers can be destroyed by Soviet X-ray lasers launched shortly before a Soviet offensive.

They are too costly, critics argue, because there is no way to produce them more cheaply than their targets. The expense of immense mirrors for lasers, accelerators for particle beams, and thousands of rocket projectiles is too great. The Soviets can therefore overcome



# STAR WARS

such a system just by building more ICBMs.

SDI proponents deny that space-based weapons are impossible to defend. "In World War I, people started to shoot at airplanes, but that was not the end of aircraft," says Maj. Peter Worden, assistant to SDI Director Lt. Gen. James A. Abrahamson. "We can use the same types of defences as aircraft used: armour, manoeuvrability, deception, dispersion ... and shooting back!"

As to cost, Gerald Yonas, SDI's scientific director, counters, "We are working on advanced automation and mass-production technologies to reduce the cost of all the systems we might deploy. We also have a tremendous cost advantage in launching our system into space in peacetime. With advanced, high-capacity boosters, we can do this much more cheaply than the Soviets can boost warheads into space during an attack."

Countermeasures can themselves be countered, Yonas points out. "We are developing cheap and effective ways of sorting out decoys and RVs." Although

fast-burn boosters may make the defence job harder, it is not impossible, SDI supporters affirm.

Technical arguments over feasibility strongly colour and overlap with the debate on the impact of Star Wars on arms control and prospects for war and peace. To critics, deployment of a half-baked system capable of dealing with a "ragged retaliation" but not a concerted first strike, could prompt a greater willingness on both sides to strike first in a crisis. This was the same argument used against Sentinel. For the same reasons, the Soviets contend the system is aimed at negating their capacity to retaliate.

Some of the systems proposed, especially the pop-up X-ray, appear to place the launching of nuclear weapons and the start of a war into the hands of computers. "The pop-up system must respond in only seconds. How can you put a human judgment in them?" asks Kosta Tsipis of MIT's Program on Science and Technology for International Security.

Deploying such a system would violate the ABM Treaty, jeopardise any arms control agreement, and lead to

confrontation in space, Garwin and others say. "I do not look forward to having our satellites, their mines, our countermines, and so on, all floating around in the same place," Garwin warns.

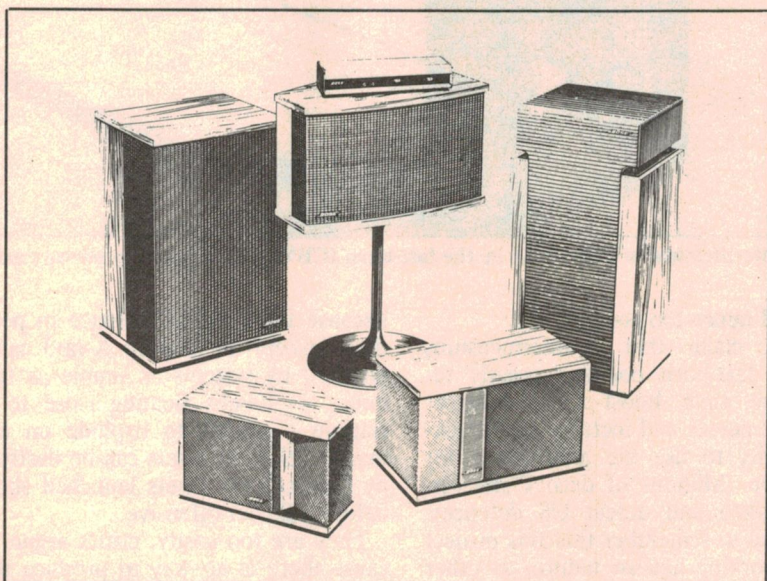
To Yonas, however, the defence effort represents the best hope for preserving world peace. "Look, the Russians are practical. If the defensive technology we deploy is really good, and they see that it is, they won't invest in more missiles, but in a defence of their own. That way we can start down a road toward arms reduction. And as the number of missiles decreases, defence looks better and better." As for confrontation during deployment, Yonas replies, "If they think defence is good for them, they'll come to terms with us that will ensure such confrontation won't ever happen. If our technology isn't so clearly superior, we wouldn't deploy it, and we won't."

Policy, therefore, as in far less momentous issues, hinges on the central question of feasibility.

EA

*Reprinted with permission from Aerospace America, August 1985, pages 38-42. Copyright © American Institute of Aeronautics and Astronautics.*

# BOSE®



## ATTENTION

Sound Professionals demand high quality loudspeaker systems at home, in the car and at work.

Only Bose hifi speakers produce a combination of reflected and direct sound, similar to what you hear at a live concert. Not to mention stereo throughout your listening room, not just between the speakers!

If you demand quality with lifelike performance you owe it to yourself to check out Bose Direct Reflecting Speaker systems for your home and car very soon.

Please send me further information on Bose Speaker Systems.

☐ Professional ☐ Car  
☐ HiFi ☐ Commercial

Name .....

Address .....

.....Postcode.....

**BOSE** (Australia) Inc, 11 Muriel Ave,  
Rydalmere, 2116 N.S.W. Ph (02) 684-1022





# Panasonic N3 in a class of its own

Every once in a while a genius is born, whose natural ability projects well above the rest.

From GEC-National comes the Panasonic N3 colour video camera, the first with 3 Newvicon half inch pick-up tubes that enable it to record high contrast subjects virtually burn free. A camera so sensitive that the signal-to-noise ratio figure is 54dB at an illumination level of 1400 lux, while minimum required illumination is 22 lux at f1.4 with 18dB gain.

Impressed?

Add to these outstanding features a newly designed auto centering circuit that gives precise registration even from the unstable position of a cameraman's shoulder, a feedback beam control circuit which

significantly reduces comet tailing, plus standard features including full field colour bar generator, auto white and black facility with memory battery and built in gen lock circuit board.

Now, can you see more clearly why the Panasonic N3 from GEC-National is certain to have a brilliant future?

The N3 is designed with ENG applications in mind and weighs only 6.5kg with 10 x zoom and 1.5 electronic viewfinder.

To find out more about this clever little video camera, send in the coupon or give us a call — the rest is academic.



DISTRIBUTORS OF:  
**National**

**VIDEO SYSTEMS**

SYDNEY (02) 887 6222  
PERTH (09) 382 1144  
ADELAIDE (08) 272 3100

MELBOURNE (03) 813 2977  
BRISBANE (07) 52 3801



Send to GEC, P.O. Box 143, North Ryde, NSW 2113.  
Please send me more information on GEC-National  
Panasonic N3 colour video camera.  
☐ Please send brochures ☐ Representative to call.

NAME: \_\_\_\_\_

COMPANY: \_\_\_\_\_

ADDRESS: \_\_\_\_\_

TEL: \_\_\_\_\_

XNEA 9/85



# COMPARE BEFORE YOU BUY

OUR PRICES

YOU BUY



Dear Customer, Over the last 9 years we at Altronics have toiled away often into the night with one major goal in mind — to provide you with competitively priced quality components and products with a superior standard of service. Looking back in 1986, I guess you could say the 10's of thousands of Shop and Mail Order Customers served, stand testament to our endeavours. We have resisted the "high powered advice" from Advertising firms to churn out expensive colour brochures and the like as eventually this must add to the cost of our products and unnecessarily waste your hard earned cash. (Even today of our products and Catalogues are produced "in house" at a fraction of the cost otherwise). The secret to our phenomenal growth we believe must lay, apart from our extremely conscientious attitude to service and delivery, in our policy of employing **Electronic Enthusiasts, Just like yourself**, in virtually every section of Altronics, so remember when you want a little technical advice — help is as close as your phone. Then of course there is the matter of our low prices!!



Jack O'Donnell

## Rack Frames for the Home Stereo System

### Rack Cabinets for Equipment Manufacturers

The all new Altronics racking system is available in 2 formats.

(1) **Racking Frame Only** Fantastic for neatly housing your home Hi Fi System. Looks fine as is with your various sound system modules bolted in place, however, should the little woman disagree, then it is dead simple to obtain some low cost timber panels from your local cabinet shop to fill the side and top recesses. Edging of the timber is not required due to the 15mm recesses.

(2) **Complete Equipment Cabinet** with the simple addition of the panel sets you now have a series of professional equipment cabinets of appearance and ruggedness second to none — and just look at the savings!

**Assembly** Each Frame System is supplied complete with 12 Custom extruded Natural Anodised Aluminium sections, 8 ABS corner connector pieces, 6 clip in M6 captive nuts and 6 M6 mounting screws. The sections and corner pieces simply push-fit together. A rubber or wooden mallet is recommended to fit together the self aligning pieces. Further strength can be obtained by pop rivetting the various overlapping extruded sections if desired, although we hardly feel this is necessary.

**Side and Top Panels** Tough powder coat medium grey gives a pleasing contrast with the natural anodised frame. The resultant product is extremely professional in appearance and well and truly strong enough for the heaviest of electronic equipment.

## New For '86

6 Unit (370mm H) 18 Unit (907mm) 30 Unit (1450mm) and 38 Unit (1804mm) Racks available All 450mm Deep

	ea.	10 Up
H 0365 Rack Frame 6 unit (370MM)	89.50	85.00
H 0367 Panel Set for H 0365	49.00	44.00
H 0370 Rack Frame 18 Unit (907MM)	119.50	110.00
H 0372 Panel Set for H 0370	89.00	84.00
H 0375 Rack Frame 30 Unit (1450MM)	149.50	139.00
H 0377 Panel Set for H 0375	129.00	119.00
H 0380 Rack Frame 38 Unit (1804MM)	189.50	175.00

	ea.	10 UP
H 0332 Panel set for H 0380	149.00	139.00
H 0385 Rack screw M6 PK 12 Natural	2.95	2.70
H 0386 Rack screw M6 PK 100 Natural	19.95	17.95
H 0390 Rack screw M6 PK 12 Black	2.95	2.70
H 0391 Rack screw M6 PK 100 Black	19.95	17.95
H 0395 Rack captive nuts M6 PK 12	3.95	3.50
H 0396 Rack captive nut M6 PK 100	25.00	22.00

## Rack Panel Screws

Low, Low prices on Nickel Plated and Black finish Rack Screws Dome Head, M6 Thread, 25mm Overall Length.



Supplied in Flat Pack Format Easily Assembled in Minutes

## New Innovation High Energy Rack Case

Yet another innovation from the Design Team at Altronics. The use of Super Heavy Duty Heatsinks as Rack Case sides now allows a myriad of Amplifiers, Power Supplies, Battery Chargers etc. to be built in an "Off the Shelf" rack case.

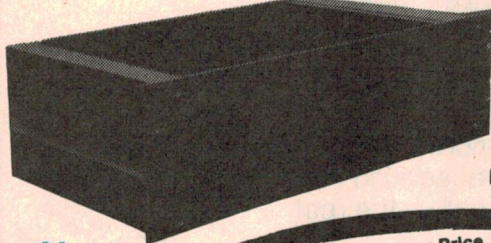
Fantastic for Stereo Amplifiers, using each Heatsink will accommodate an audio output stage of approximately 120W per side with normal efficiency and dissipation.

A Great Chassis for Heavy Duty Power Supplies and Battery Chargers. We suggest the mounting of Rectifier Bridge or diodes on one Heatsink and the Regulator devices on the other.

For very high heat dissipation this design allows the simple fitting of computer type fans to inside back of rear panel, adjacent to each respective heatsink. Fans are thus very cheap and easy to fit and provide very efficient cooling of the heatsink.

### Specifications:

**Heatsinks** Altronics H 0590 **Front Panel** 3 unit Rack size 480mm x 132mm x 3mm **Rear Panel and Base** 1.0mm steel, ventilation slots provided **Top cover** 1.0mm steel, ventilation slots provided. **Internal Dimensions** 125 x 370 x 250mm **External Dimensions** 130 x 440 x 252mm plus standard front panel. **Finish** Black anodised aluminium plus powder coat black top/base.



Vented Lid Not Shown

New For'86

Amazing Low Price  
H 0418 \$79.00  
4 Up \$74.50 ea

## Sloping Front Boxes

Give a real Professional appearance to your desk mounted consoles, controllers etc.

- Colour Hammertone finish
- 18G Steel
- Non-Slip rubber feet



Size 1 150 x 105 x 35 (F) x 73 (R)

H 0432 \$9.50 5 Up \$8.50

Size 2 200 x 150 x 35 (F) 70 (R)

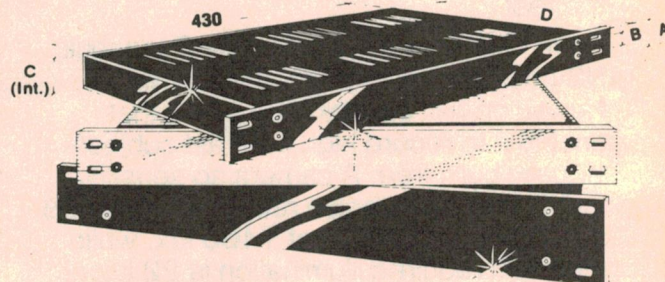
H 0434 \$12.95 5 Up \$11

Size 3 262 x 150 x 32 (F) x 89 (R)

H 0438 \$16.95 5 Up \$15

## PROFESSIONAL SERIES RACK CABINETS

Now your preamps, Amps, Control Modules Monitor Panels etc. can look every bit as good as Technics Nakamichi and other top manufacturers.



### ALL ALUMINIUM CONSTRUCTION

**FEATURES:** These beautifully crafted rack cabinet boxes will give your equipment a real 1st class appearance with removable top and bottom cover panels • All dimensioning conforms to the International Standard • Natural or Black finish • Ventilated lid • Deluxe finish front panel • Individually cartoned • Supplied in Flat Pack Form - Easily assembled in minutes - **Side Elevations:** - D=254mm C (Internal Chassis Height) • B (mounting Bolt Centres).

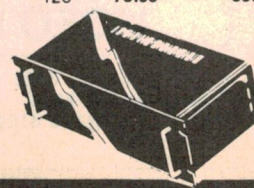
**SIX NATURAL AND BLACK FINISH MODELS** — The Black or Natural finish cabinets are each available in 44mm, 88mm or 132mm high models. Mounting hole centres conform exactly to International Racking Specifications both vertically and horizontally.

Cat. No.	Finish	A	B	C	ea.	5 +
H 0401	Natural	44	34	38	\$49.95	\$47.50
H 0402	Natural	88	57	82	59.50	56.00
H 0403	Natural	132	89	126	69.50	62.95
H 0411	Black	44	34	38	55.00	50.00
H 0412	Black	88	57	82	65.00	59.50
H 0413	Black	132	89	126	75.00	69.50

## Economy Pack Cabinet

• Solid steel construction • Black anodised front panel • 3 unit (132mm) • Conforms to International Standards • Ventilated top and side panels. H 0400

10 Up ONLY \$49.50 \$45





## Toroidal Power Transformers

### Why a Toroid?

- Smaller size and weight to meet modern "Slimline" requirements.
- Low electrically induced noise demanded by compact equipment.
- High efficiency enabling conservative rating whilst maintaining size advantages.
- Lower operating temperature.
- Simple, quick single bolt mounting.

### Dimensions and Weight

**160 VA Models** 110 Diam. 45mm  
H. 1.8Kgs Leads 200mm  
**300 VA Models** 125 Diam. 45mm  
H. 2.5Kgs Leads 200mm

### 160 Watt Models

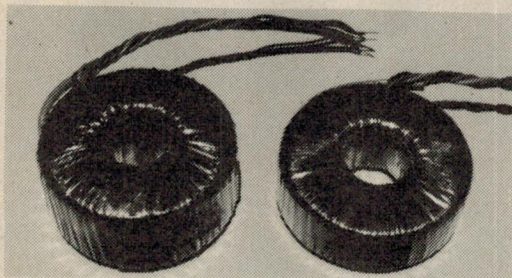
Cat.No.	SEC.V
M 3050	12 + 12
M 3055	18 + 18
M 3060	25 + 25
M 3065	30 + 30
M 3070	35 + 35
M 3075	40 + 40

All \$45ea 10 Up \$43.50

### 300 Watt Models

Cat.No.	SEC.V
M 3085	12 + 12
M 3086	18 + 18
M 3088	25 + 25
M 3090	30 + 30
M 3092	35 + 35
M 3100	40 + 40

All \$55ea 10 Up \$52.50



## Low Cost Multipurpose Power Transformer

240V to 9, 12, 15, 18, 21, 24 volts at 60VA (60W) High grade silicon steel laminations (Sorry we could not do a Toroid at this price).

Our Multitap 1 amp and 2 amp Transformers have proved so popular we decided to release a big brother. Made right here in Australia. Use of high grade Silicon steel has enabled surprisingly compact dimensions (70mm x 70mm x 58mm High).



### M 2165 Outputs

Two Simple Secondaries, each with just one tap, permit an amazing range of outputs i.e.

9V @ 6.6A	12V @ 5A	18V @ 3.3A	24V @ 2.5A
<b>Voltage</b>	<b>Current</b>	<b>Centre Tap</b>	
3	6.6A	No	
6	6.6A	Yes	
9	6.6A	No	
12	5A	No	
15	4A	No	
18	3.3A	Yes	
21	2.9A	No	
24	2.5A	Yes	

An exclusive Altronics Design

Just \$22.50

Super Versatile Exclusive to Altronics

## New PCB Mount Mains Transformers

7/9 Rating. Super Compact, wound on Grain Oriented Steel Core for High efficiency and low temperature rise.

### Power Rating:

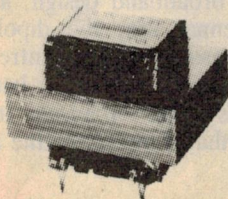
7VA Load Full voltage +3% -0%  
9VA Load Full voltage -6% to 8%

### Model Prim/SEC's

M 7012	240/6+6
M 7015	240/7.5 + 7.5
M 7018	240/9+9
M 7024	240/12+12
M 7030	240/15+15

Overall Height 36mm  
Length 43mm  
Width 36mm

1—9	\$9.80ea
10—24	\$9.20ea
25 Plus	\$8.40ea



## Mu Metal Shielded Microphone and Input Transformers

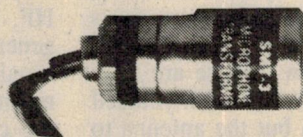
### Microphone Type

Primary: 200 Ohm

Secondary: 50K Ohm

A high quality item eminently suited to mixers, PA amplifiers and where an ultra low "hum" pickup level is desired.

M 0701 \$19.50 10 up \$18.30



### Bridging/Isolating type

Use for coupling audio modules—prevents earth loops, hum etc. Essential coupling device where DC isolating is required.

Nominal Impedance Ratio  
10K/10K (1:1)

M 0702 \$19.50 10 up \$18.30

## Low Cost IC Inserters Extractors

INSERTERS EXTRACTORS

### Features:

- CMOS SAFE conductive plastic.
- Exclusive bent pin alignment guides in handle. 8 to 40 pins.
- Ground strap can be connected.
- One hand operation.

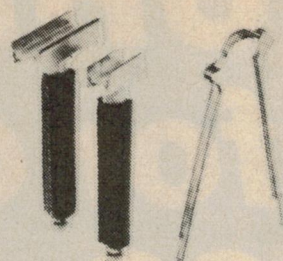
T 2520 IC Inserter 14/16 Pin \$7.95

T 2524 IC Inserter 18/20 " \$7.95

T 2528 IC Inserter 24/28 " \$8.95

T 2536 IC Inserter 36/40 " \$8.95

T 2550 IC Extractor 8-40 " \$2.95



## Stereo Mixers at Low Import Price

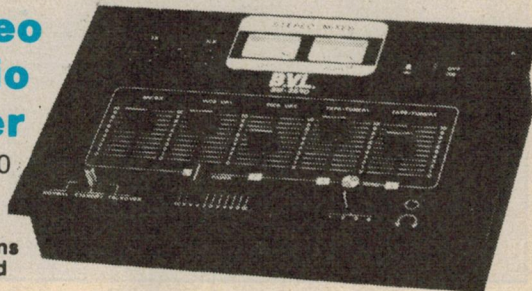
**ATTENTION**—Social Clubs, Schools, Churches, Disco Operators, Entertainers, Hotels, Night Clubs and sporting Bodies. With Altronics low prices—here is your opportunity to install one of these outstanding sound control mixers. Both models include microphone "Soundover" facility—making either ideal for live entertainment use.

## Stereo Audio Mixer

A 2550

\$125

240V Mains Operated



This brilliant little mixing console is absolutely packed with features. Allows blending of Microphone, two Phono inputs and either two Tape or Turner inputs • Right and left VU meters • Separate Bass and Treble controls • 5 slide level controls • Fader control between Phono pickups for professional cueing • Headphone monitor switch • Talkover facility.

### SPECIFICATIONS:

• Input Mic 0.5mV 600 Ohms Phono 3mV 50K Ohms Tape/Tuner 150mV 100K Ohms • Output 250mV • Frequency Response 20Hz to 20KHz (plus or minus 1db) • Tone Control (Treble) 10KHz (plus or minus 12db) • Tone Control (Bass) 100Hz (plus or minus 12db) • Distortion Less than 0.07% • S/N Ratio More than 60db • Headphone Impedance 4—6 Ohms • Dimensions 318 (L) x 217 (W) x 85 (H)

## Pro-Quality Stereo Console



240V Mains Operated  
AMAZING VALUE

A 2570 \$399

Our sophisticated 'NEW' Audio Mixing Console is ideal for 'live' recording • PA mixing • Fantastic Tape recordings • Even Stereo/Mono VCR recording. A truly professional deck that features separate R/L 5 band graphic equalisers • Echo and Peak LED level indicators • Talkover facility • Separate H/Phone level control • Patch switch bank • Individual microphone, Phono 1 Phono 2, Aux/Line 1, Aux/Line 2, and Master slide level controls. — Blend up to two magnetic or crystal turntables, two tape decks or tuners and two microphones all at once!!

### SPECIFICATIONS:

• Input Mic 1—0.5mV 600 Ohms Mic 2—0.5mV 600 Ohms Mic 3—0.5mV 600 Ohms (low imp.) 2.5mV 10K Ohms (low imp.) Phono 1 & 2 (Mag) 3mV 50K Ohms Phono 1 & 2 (Cry) 150mV 100K Ohms Tape/Tuner 1 & 2 150mV 100K Ohms • Equaliser 5 frequency bands—60Hz, 250Hz, 1KHz, 4KHz, 12KHz—Boost Cut range—plus or minus 12db @ Centre frequency. • Output 1.5V/0.775V (Selectable) • Frequency Response 20Hz to 20KHz plus or minus 1db • Distortion Less than 0.05% • S/N Ratio More than 50db

• Headphone Impedance 4—16 Ohms • Echo B.B.D. System • Delay Time 30—200ms • Echo Repeat Control • Delay Time Control • Dimensions 480 (L) x 240 (W) x 110 (H)



# UHF antenna for channel 28



*Save money by building this high-gain Yagi antenna for UHF band 4, 520 to 620MHz. It is an 18-element Yagi design with 16 directors, folded dipole and a corner reflector and it gives a performance comparable with the best commercial antennas currently available.*

**by BOB FLYNN & LEO SIMPSON**

For many years now, building TV antennas has not been a popular pastime with electronics enthusiasts. Principally this has been because commercial VHF antennas have been reasonably priced and of good performance. There has also been a continuing problem with the non-availability of special brackets and saddles to attach the various elements to the boom and the quantity of aluminium needed to make an antenna equivalent in performance to a commercial design has been quite expensive.

So much so that few people have bothered with making their own TV antenna although we have published articles on the subject, the most recent being the six-part series entitled "How to obtain better TV reception" (June

1983 to March 1984).

UHF antennas are a different proposition though. For a start they are nowhere near as large and unwieldy and they can be built using a relatively small quantity of aluminium which can be of thicker stock than an equivalent commercial model. They also can be built without resorting to special hardware, and can be assembled using pop rivets or self-tapping screws.

This does not mean that we are forecasting a renaissance of do-it-yourself antenna construction but the antenna to be described is quite a practical proposition for those with access to basic metal-working tools, ie, vice, hacksaw, electric drill and pop-rivet gun.

In setting out to present this project,

we decided to produce a design for fringe-area reception. The reasoning behind this is that UHF antennas for close metropolitan reception are cheaper and therefore there is less advantage in building your own.

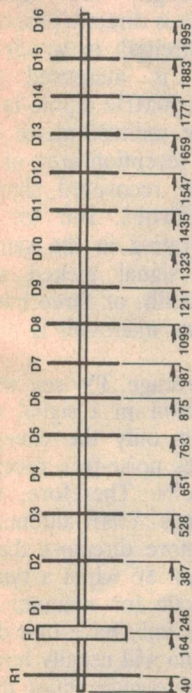
Hence we decided to produce a design which would have a performance at least equivalent to the most popular fringe antenna currently on the market, the Hills TC18. This is a tried and tested unit, based on a design from the UK company, Antiference. Accordingly, we have produced a design which is roughly equivalent. The major difference is that our design has been optimised for channel 28 which is presently the only one operating in the Australian UHF Band 4.

## **Antenna design**

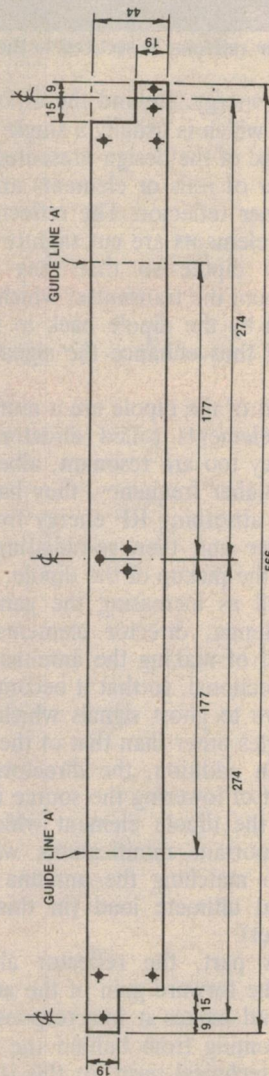
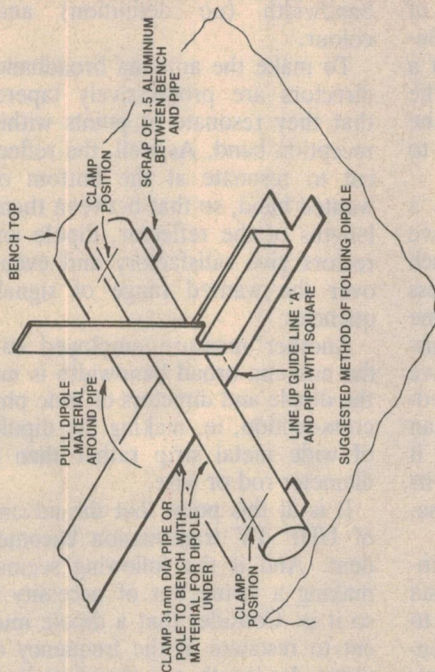
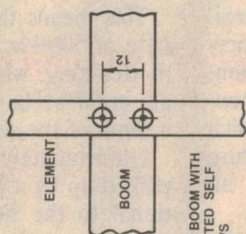
A typical Yagi, whether designed for HF, VHF or UHF, follows the same general principles. There is a dipole, usually a folded type, which is cut to be resonant at the frequency of interest. In the case of a broadband design, as all television antennas are, the dipole is usually cut to resonate at the centre frequency of the wanted channel or band.

The dipole is aimed broadside at the transmitter so that it intercepts the radi-





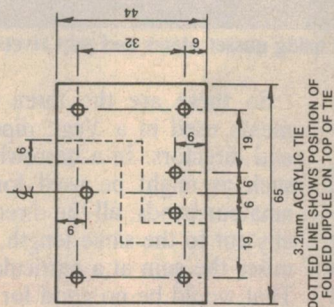
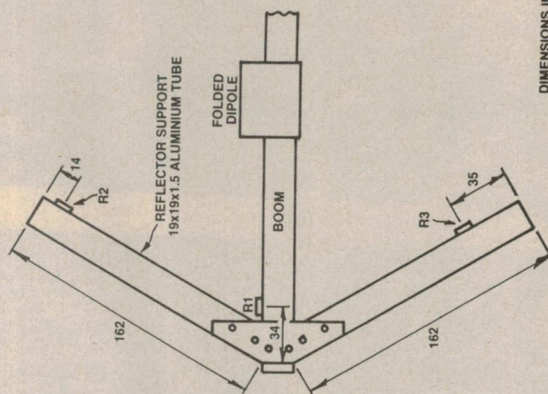
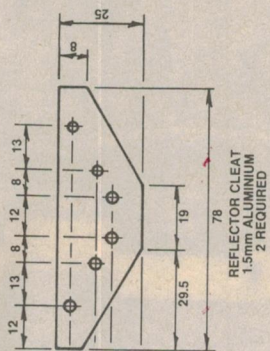
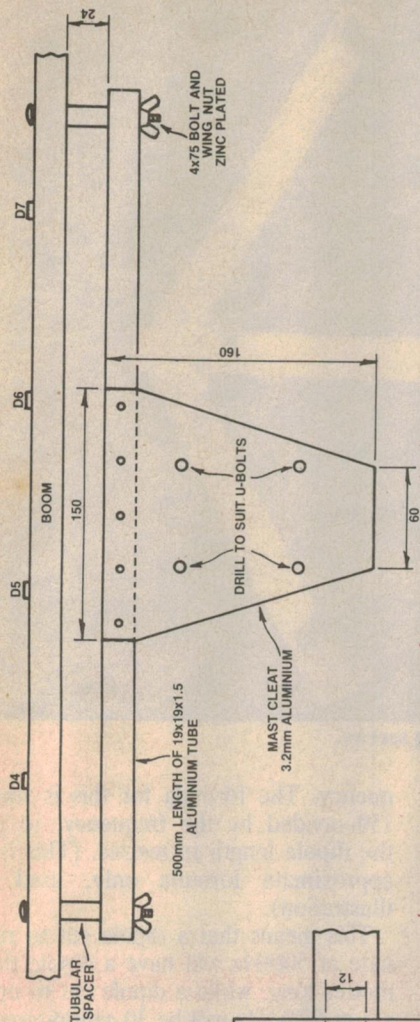
FASTEN ALL ELEMENTS TO BOOM WITH  
POP RIVETS OR ZINC PLATED SELF  
TAPPING SCREWS



6/ATV

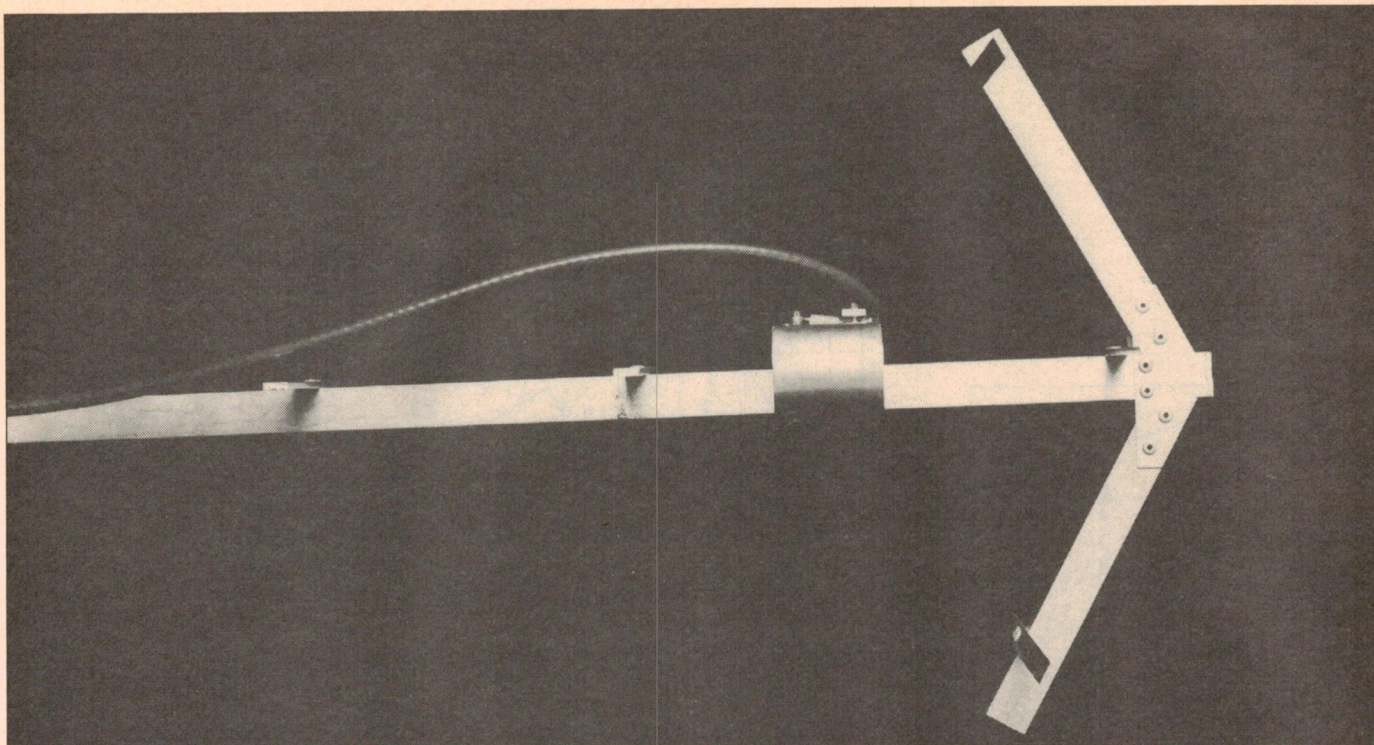
## CHANNEL 28 ANTENNA

DIMENSIONS IN MILLIMETRES



6/ATV





The corner reflector is secured to the boom using gusset plates and pop rivets or self-tapping screws.

ated RF energy. Behind the dipole is a reflector which is usually a single rod or in the case of the design presented here, a number of rods or elements arranged as a corner reflector. The reflector element or elements are cut slightly longer than the dipole so that they reflect energy from the transmitter which is not absorbed by the dipole back to the dipole and thus enhance the signal pickup.

In front of the dipole are a number of shorter elements called directors. Because they too are resonant, albeit at a slightly higher frequency, they have the effect of absorbing RF energy from the transmitter and then re-radiating it to increase the pickup of the dipole.

As well as increasing the gain of a Yagi antenna, director elements have the effect of making the antenna much more directional, so that it becomes less responsive to ghost signals which come from angles other than that of the transmitter. In addition, the directors have the effect of lowering the source impedance of the dipole element which can have important ramifications when it comes to matching the antenna to its cable and ultimate load (in this case, the TV set).

For its part, the reflector also increases the forward gain of the antenna system and makes it less responsive to signals coming from behind the antenna. The technical term for this is front-to-back ratio.

So these are the three sorts of elements used in a Yagi: dipole, reflector and directors. In a narrowband antenna such as might be used for one of the amateur bands, all the directors are usually cut to the same length, which maximises the gain at a particular frequency. That would be no good for a TV antenna, even one intended for a single channel, as it could result in reception which might lack sound or have poor picture bandwidth (no definition) and no colour.

To make the antenna broadband, the directors are progressively tapered so that they resonate at points within the reception band. As well, the reflector is cut to resonate at the bottom of the wanted band, so that between them, the lengths of the reflector, dipole and directors give satisfactory and even gain over the wanted range of signal frequencies.

Another measure employed to give the antenna broad bandwidth is making the dipole and directors of wide physical cross-section, ie, making the dipole out of wide metal strip rather than small diameter rod or wire.

It is at this point that the advantages of UHF TV transmission become evident. And if the following seems like making a virtue out of necessity, then so it is. Consider that a dipole must be cut to resonate at the frequency of interest. Its length will therefore be close to one half wavelength of the signal fre-

quency. The formula for this is simply 150 divided by the frequency, to give the dipole length in metres. (This is an approximate formula only, used for illustration).

This means that a dipole cut to resonate at 50MHz will have a dipole three metres long, while a dipole cut to operate at 500MHz will be 30 centimetres or a tenth of the size for 50MHz.

Unfortunately though, the signal picked up by a dipole is directly proportional to the field strength in which it operates and this is measured in volts/metre. So for a 50MHz dipole in a field strength of one millivolt/metre (a typical signal in the reception area of a TV transmitter), the recovered signal would be three millivolts. But for a 500MHz dipole operating in the same field strength, the signal picked up would only be one tenth, or three hundred microvolts. (One microvolt is one millionth of a volt).

Now while the average TV set will give excellent reception on a signal of three millivolts, it is only the exceptional set which gives noise-free reception at 300 microvolts. Therefore, to make up the difference, UHF antennas usually have a lot more directors than typical VHF antennas. So while a typical VHF antenna cut for channel 2 (around 65MHz) will only have one director, a UHF antenna will usually have 10 or more directors to give about the same signal.



# SCAN-SPEAK 200 & 300

The professional kits from the  
kit professionals.



**SCAN-SPEAK 300 Kit**  
**Total kit price \$1598**

**INTRODUCTION PRICE  
IN APRIL ONLY:**

**\$1399**

**incl. cabinets and freight**

The new SCAN-SPEAK 300 is a larger version of the successful model 200. The powerful 10" woofer gives an extended bass response down below 40 Hz. At the same time, it can produce very high power level, even with medium sized amplifiers, due to its high efficiency.

FOR MORE INFORMATION ON THESE KITSPEAKERS PLEASE CONTACT THE  
SOLE AUSTRALIAN DISTRIBUTOR:

**SCAN AUDIO Pty. Ltd.**  
**52 Crown St., Richmond 3121**  
**Ph. (03) 429 2199**



**SCAN-SPEAK 200 Kit**  
**Total kit price \$898**

The Scan-Speak 200 Kit offers you the opportunity to build and enjoy a speaker system which produces magnificent results over the entire sonic spectrum – at a price which would be trebled, or more, in ready-made imported speakers.

The key to performance lies in the components used. Both the woofer (180mm) and the ferro-fluid soft textile dome tweeter (19mm) are manufactured in Denmark by Scan-Speak. Their drivers are chosen by such world leading names as ProAc, Linn, NAD, Carlsson, Rogers – just to name a few.

The dividing network is a most advanced L-C design, using metalised polypropylene capacitors with a polystyrene by-pass, giving the speakers an outstanding transient response. The heavy-duty inductors are air cored, using far thicker wire than commercial x-overs. The internal wiring is done with 516 strands cables.

The result is a sound that the hi-fi critics now are raving about:

"An impressive debut from Scan-Speak...should leave most of the competition at the post."

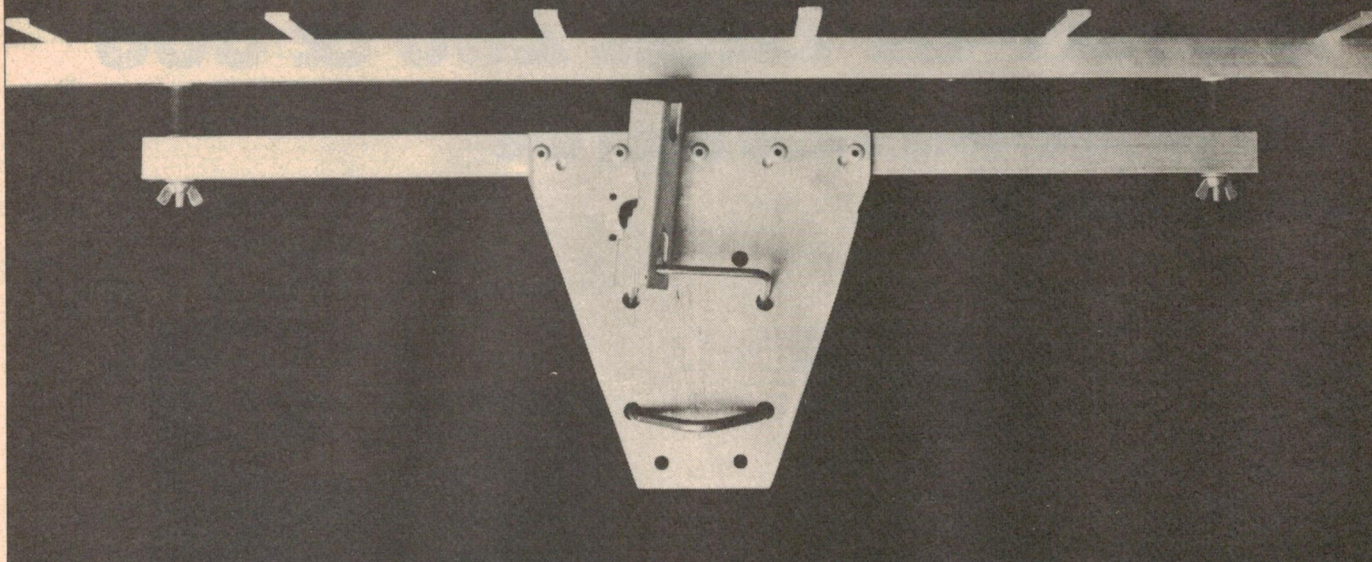
"Imaging was very good indeed to excellent...instruments were well placed and rock solid in position, with a sense of space around them... The midrange was smooth and the treble transparent and detailed."

"...unfussed on complex orchestral and massed choral works. ...bass was deep...no sign of doubling even at the lowest frequencies..."

Frequency response is 50 to 20kHz  $\pm 3$  dB, sensitivity is 89 dB, crossover point 3kHz, and 2nd and 3rd harmonic distortion is less than 0.7% (100 to 20kHz).

The kit comes with easy-to-follow instructions. No carpentry skills are required. All exposed cabinet areas are timber veneered. When assembled, each speaker measures 65 x 26 x 36cm. The optional stand is veneered and lifts the speaker 30cm from the floor. The price is \$68.00 per pair.





The main boom is supported by a shorter parallel boom attached to the mast via a large gusset plate and two U-bolt clamps.

## Antenna

The net effect is that UHF antennas are much more directional than typical VHF antennas and so give reception which is much less plagued with ghosts. That is the virtue of necessity, referred to above. When you consider that UHF TV reception is also just about immune to most sources of man-made electrical interference, it has quite an advantage.

So the design presented here has 16 directors, a folded dipole and a corner reflector. The reason a corner reflector is used instead of a single reflector element is that it improves the front-to-back ratio, increases the gain slightly (over a single element reflector) and reduces the vertical acceptance angle. This last factor means that the antenna will be less responsive to signals reflected by aircraft which, in severe cases, can be sufficient to cause very bad rapidly moving ghosts and picture flutter.

By the way, we refer to the design presented here as an 18-element Yagi, ie, dipole, reflector and 16 elements. That is in line with Australian and European practice. Some manufacturers prefer, for obvious reasons, to count all the reflector components as elements. By that criterion, our design could be called a 20-element unit.

The reason such a rating method is not ideal is that each additional element in a corner reflector gives very little, if any gain, whereas each additional director means an increase in the overall length of the antenna (for the boom) and a greater increase in cost, which is

why some manufacturers prefer to count every separate part as an element.

### Construction

So much for the theory. Our antenna design is built around a 19mm square section aluminium extrusion with a wall thickness of 1.5mm. This square section makes for a strong boom to which the various elements can be easily attached. The 16 directors and three reflector elements are made from aluminium strip with 3 x 10mm cross-section.

The accompanying drawings show the lengths and positions of all elements on the boom and show how the corner reflector is assembled. Each element is secured to the boom via two pop rivets, or failing those, via two galvanised self tapping screws. Note that the directors are progressively tapered in length, in groups of four, from 231mm to 198mm. Their spacing also progressively reduces from director D1 to D4 and then stays constant at 112mm for successive director elements.

Accuracy of metalwork is particularly important for a UHF antenna such as this and so the specified dimensions should be adhered to as closely as possible.

The folded dipole is fashioned from a strip of 1.5mm thick aluminium, 44mm wide and 566mm long. This has notches cut into each end before folding and should also be drilled as shown.

The method of folding is also illustrated in the diagram. Briefly, the method is as follows. Clamp the prepared strip of aluminium to your bench or table together with a pipe or dowel of 31mm diameter. Then use your set

square to line up with one of the "A" guide lines. This is so that the two radiused bends are precisely located. This done, fold the dipole up and over the pipe, in the direction of the arrow. The process is then repeated for the other end of the dipole. When finished, the two free ends of the dipole should be lined up and with a gap of about 6mm.

This gap is bridged and supported by a tie piece fashioned from a piece of 3.2mm thick clear acrylic material (Lexan or Perspex) measuring 44 x 65mm. This is secured to the ends of the dipole using four plated 6BA screws, nuts and lockwashers. Alternatively, four pop rivets could be used.

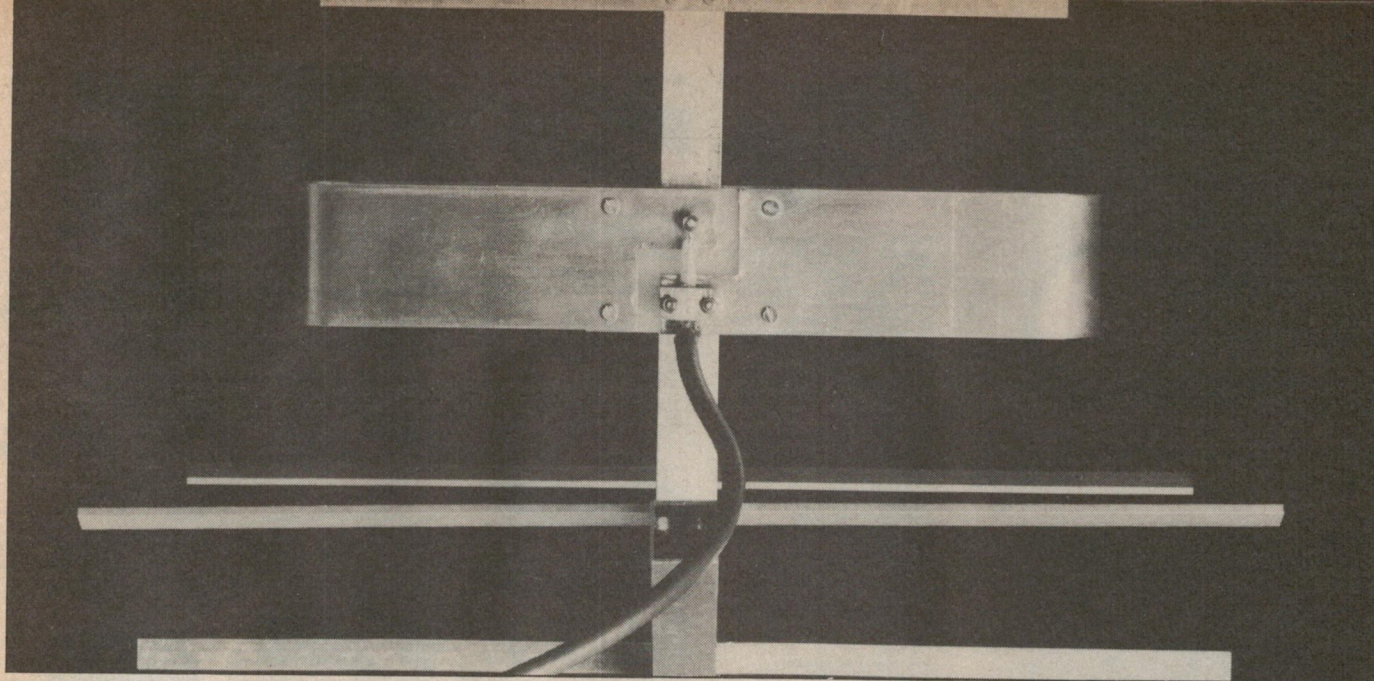
The dipole is secured to the underside of the boom using three pop rivets or self tapping screws.

As mentioned above, the antenna employs a corner reflector, which consists of three elements. Reflector element R1 is attached to the boom while elements R2 and R3 are attached to angled members made from the same square section tube as the boom. These are 162mm in length and are attached to the boom with the aid of gusset (cleat) plates, made of 1.5mm thick aluminium and also attached with the aid of pop rivets or self-tapping screws.

The pop rivets should preferably be of the closed type (for waterproof applications) and have aluminium instead of steel mandrels, to minimise the chance of corrosion.

The boom is supported and strengthened by a short parallel boom attached to it by 75mm x 4mm bolts and wing nuts and spaced away from it by 25mm, by tubular spacers. These may be of





The download is connected directly to the dipole. Use a plastic jar lid and silicone caulk to weather-seal the termination.

fibre or aluminium. This short boom section is then attached to the mast via a large gusset plate made of 3.2mm thick aluminium. This is drilled to take two mast clamp and saddle assemblies. These allow the antenna to be securely mounted to the mast as well as allowing it to be fixed horizontally or aimed slightly upwards, if necessary to optimise signal pickup. The saddles of the mast clamps should be against the gusset so that they contribute to its stiffness.

### Termination

No balun is necessary to match this antenna to 75-ohm coax cable. We have tried it directly connected to the TV set via cable or via a VHF/UHF diplexer such as the model made by Hills. In both cases the performance was very good.

The cable inner conductor is terminated to one side of the dipole via a plated 6BA screw with washers and nuts to lock the connection. The shield and outer cable itself is clamped to the other side of the dipole with a short clamp made from scrap aluminium secured with two 6BA screws with nuts and lockwashers.

The whole cable termination should be protected from the elements with a suitably sized plastic jar lid cut to fit snugly over the cable. The assembly is then sealed and fixed in place with silicone sealant. To prevent strain on the cable it should be secured to the boom and mast with plastic cable ties.

We also suggest that the ends of the booms and reflector assembly be sealed to stop whistles from the wind. This can

be done by stuffing the ends with paper and then sealing them flush with epoxy resin. Alternatively aluminium centres can supply Delrin plugs to suit.

To protect the whole antenna from the elements, especially if you live by the seaside, we suggest it be painted with an etch primer and finished with an aluminium loaded paint such as British Paints "Silvar".

Our tests indicate that the prototype antenna had a performance which was at least as good as, if not slightly better than the benchmark antenna, the Hills TC18/B4, at least as far as SBS channel 28 signals in Sydney are concerned. The prototype antenna appeared to have slightly more gain and slightly better front-to-back ratio. (For reference, the Hills TC18/B4 has a claimed gain of 14.7dB and a front-to-back ratio of 30.7dB. For those not in the business of making their own, it is a very good antenna.)

### Bill of materials

- 3 metres of 19mm square section tubing with 1.5mm wall thickness
- 5 metres of aluminium strip, 3 x 10mm cross-section
- 600mm of 1.5mm thick aluminium, 44mm wide
- Six dozen pop rivets or galvanised self-tapping screws
- 2 U-bolt pipe clamps to suit mast
- 2 75mm long galvanised 4mm diameter bolts and wingnuts to suit
- 2 tubular spacers to suit bolts
- 6BA screws, nuts and lockwashers

### Miscellaneous

Scrap 1.5mm and 3.2mm thick aluminium, epoxy adhesive, scrap Lexan, paint as specified in article.

## Clearance sale

Your chance to buy well known Silver-Reed Daisy Wheel Printers still in manufacturers carton,

**EXP550 Parallel**  
**EXP550 Serial**

- Print speed 19 cps (max)
- First rate letter quality

Excl Sales  
Tax

**\$380 EA**  
**\$380 EA**

Incl Sales  
Tax

**\$420 EA**  
**\$420 EA**

- Bidirectional
- Paper width 432 mm (17 in)

For further details contact:- Roger Cotterell

VSI Electronics (Aust) Pty Ltd 16 Dickson Ave,  
ARTARMON NSW 2064. Tel: (02) 439 4655

WELL  
BELOW  
COST PRICE





**SPECIAL OFFER \$69.95 DURING MAY**

## 605 3 1/2 DIGIT MULTIMETER

New replacement for YF1100. See specification tables below for details.

Cat. Q11035 ..... **\$79.95**



**SPECIAL OFFER \$109 DURING MAY**

## 705A 3 1/2 DIGIT MULTI/CAPACITANCE METER

See specification table below for details.

Cat. Q11040 ..... **\$119**

### 605 & 705A SPECIFICATIONS

Capacitance		605	705A	Test Signal		Max. Input
Range	Resolution	Accuracy				
2nF	1pF			400mV rms		
20nF	10pF					
200nF	100pF	NC	35% +4	512 Hz		3V DC/peak AC on all ranges
2000nF	1nF			40mV rms		
20uF	10nF					

AC Current		605	705A	Burden Voltage		Overload Protection
Range	Resolution	Accuracy				
200uA	100nA	NC				705A: 0.2A fuse up to 250V
2mA	1uA		12% +4	0.3V max		605: 2A fuse up to 250V
20mA	10uA	12% +4				10A range not fused
200mA	10mA	2% +4	NC			
10A	10mA	1.5% +4	1.5% +4	0.7V max		

Resistance		605	705A	Open Voltage		Overload Protection
Range	Resolution	Accuracy				
200Ω	100mΩ	1% +2	1% +2			
2KΩ	1Ω					
20KΩ	10Ω					
200KΩ	100Ω	0.8% +2	0.8% +2	HV < 3.5V		250V DC/rms on all ranges
2000KΩ	1KΩ			LoV < 0.25V		
20MΩ	10KΩ	2% +4	2% +4			

DC Voltage		605	705A	Input Impedance		Overload Protection
Range	Resolution	Accuracy				
200mV	100uV					
2V	1mV	0.5% +1	0.5% +1	10MΩ		1000V DC/peak AC on all ranges
20V	10mV					
200V	100mV					
1000V	1V	0.8% +1	0.8% +1			

AC Voltage		605	705A	Input Impedance		Overload Protection
Range	Resolution	Accuracy				
200mV	100uV					
2V	1mV	1% +4	1% +4	10MΩ on all ranges		750V rms on all ranges except 200mV AC ranges (15 seconds max above 250V rms AC)
20V	10mV					
200V	100mV					
750V	1V	2% +4	2% +4			

DC Current		605	705A	Burden Voltage		Overload Protection
Range	Resolution	Accuracy				
200uA	100nA	NC				705A 0.2A fuse up to 250V
2mA	1uA		1% +1	0.3V max		605: 2A fuse up to 250V
20mA	10uA	1% +1				10A range not fused
200mA	10mA	1.5% +1	NC			
2000mA	100mA	1% +1	1% +1	0.7V max		

NC = Not Connected



### METEX 3800 MULTIMETER

This instrument is a compact, rugged, battery operated, hand held 3 1/2 digit multimeter for measuring DC and AC voltage, DC and AC current, Resistance and Diode, for testing Audible continuity and transistor hFE. The Dual-slope A-D Converter uses C-MOS technology for auto-zeroing, polarity selection and over-range indication. Full overload is provided. It is an ideal instrument for use in the field, laboratory, workshop, hobby and home applications.

- Features...**
- Push-button ON/OFF power switch.
  - Single 30 position easy to use rotary switch for FUNCTION and RANGE selection.
  - 1/2" high contrast LCD.
  - Automatic over-range indication with the "1" displayed.
  - Automatic polarity indication on DC ranges.
  - All ranges fully protected plus Automatic "ZERO" of all ranges without short circuit except 200 ohm range which shows "000 or 001".
  - High Surge Voltage protection 1.5 KV-3 KV.
  - Diode testing with 1 mA fixed current.
  - Audible Continuity Test.
  - Transistor hFE Test.

**SPECIFICATIONS**  
Maximum Display: 1999 counts  
3 1/2 digit type with automatic polarity indication.  
**Indication Method:** LCD display.  
**Measuring Method:** Dual-slope in A-D converter system.  
**Over-range Indication:** "1" Figure only in the display.  
**Temperature Ranges:** Operating 0°C to +40°C  
**Power Supply:** one 9 volt battery (006P or FC-1 type of equivalent)  
Cat. Q15930 **Normally \$99.95 SPECIAL \$79.95**



### METEX 3530 MULTIMETER

This instrument is a compact, rugged, battery operated, hand held 3 1/2 digit multimeter for measuring DC and AC voltage, DC and AC current, Resistance and Diode, Capacitance, Transistor hFE and Continuity Test. The Dual-slope A-D Converter uses C-MOS technology for auto-zeroing, polarity selection and over-range indication. Full overload is provided. It is an ideal instrument for use in the field, laboratory, workshop, hobby and home applications.

- Features...**
- Push-button ON/OFF power switch.
  - Single 30 position easy to use rotary switch for FUNCTION and RANGE selection.
  - 1/2" high contrast LCD.
  - Automatic over-range indication with the "1" displayed.
  - Automatic polarity indication on DC ranges.
  - All ranges fully protected plus Automatic "ZERO" of all ranges without short circuit except 200 ohm range which shows "000 or 001".
  - High Surge Voltage protection 1.5 KV-3 KV.
  - Capacitance measurements to 1pF
  - Diode testing with 1 mA fixed current.
  - Audible Continuity Test.
  - Transistor hFE Test.
- SPECIFICATIONS**  
Maximum Display: 1999 counts  
3 1/2 digit type with automatic polarity indication.  
**Indication Method:** LCD display.  
**Measuring Method:** Dual-slope in A-D converter system.  
**Over-range Indication:** "1" Figure only in the display.  
**Temperature Ranges:** Operating 0°C to +40°C  
**Power Supply:** one 9 volt battery (006P or FC-1 type of equivalent)  
Cat. Q15140 **Normally \$129 SPECIAL \$109**

### 2K OHM MULTI METER

11 Ranges, pocket size.  
**SPECIFICATIONS:**  
11 RANGES  
DC VOLTAGE: 0-10-50-250-1000 volts 2000 ohms/volt  
AC VOLTAGE: 0-10-50-250-1000 volts 2000 ohms/volt  
RESISTANCE: 10-100-1000-100K-1M-10M-100M-1000K-10M-100M  
OHMMETER: 0-10 kΩ/hms, 0-1 mega-ohms.  
DC CURRENT: 1-100mA  
Cat. Q11020 **Normally \$26.95 SPECIAL, ONLY \$21.50**



### JIFFY BOXES

Plastic boxes with aluminum tops, and available in four sizes. Very popular for projects and very economical!

H10101 150x90x50mm	\$ 3.25
H10102 195x113x60mm	\$ 4.50
H10103 130x68x41mm	\$ 2.75
H10105 83x54x28mm	\$ 1.95
H10110 120x65x38mm	\$ 2.95
H10112 120x65x38mm (Metal top)	\$ 2.95



**MINI UTILITY CASE**  
Features a clear plastic lid for instant inspection of contents. Up to five, adjustable lower compartments, plus a self elevating upper tray for smaller items.  
Dimensions: 110 x 210 x 43mm.  
Cat. H10087 **Normally \$7.95 SPECIAL, ONLY \$6.95**



**IC STORAGE CASE**  
Electro static charge proof plastic IC case with conductive sponge.  
Dimensions: 75 x 130 x 19mm.  
Cat. H10095 **NORMALLY \$8.95 SPECIAL, ONLY \$7.95**



**POWERFULL MINI DRILL**  
Featuring a powerful 6000 r.p.m. motor, this lightweight (113gm) drill is ideal for many jobs. Perfect for PCB work! Has a 0.8 to 1.2mm chuck and 1mm drill bit.  
Requires 12V 1 AMP. (use with M19010)  
Cat. T12302 **Normally \$17.95 SPECIAL, ONLY \$14.35**



**MITSUBISHI DISK DRIVES**  
**MF353 (3 1/2" DRIVE)**  
Double sided, double density, 1 MByte unformatted, 80 track per side.  
Cat. C11953 **\$280**  
**MF351**  
3 1/2" Standard size disk drive. Single sided, double density.  
Cat. C11921 **\$225**  
**M2896-63**  
Slimline 8" Disk Drive, Double sided Density No AC power required. 3ms track to track, 1.6 Mbytes unformatted, 77 track side 10s/su 10 bit soft error rate.  
Cat. C11916 **\$550**  
Case & Power Supply to suit  
Cat. X11022 **\$159**  
**M4854**  
Slimline 5 1/4" disk drive. Double sided, double density, 96 track/inch, 9621 bit/inch, 1 MByte unformatted 3ms track to track access, 77 track/side.  
Cat. C11904 **\$350**  
Case & Power Supply to suit.  
Cat. X11011 **\$109**  
**M4853**  
Slimline 5 1/4" disk drive. Double sided, double density, 1 MByte unformatted, 3ms track to track, 80 track/side, 5922 bits/inch.  
Cat. C11903 **\$260**  
**M4851**  
Slimline 5 1/4" disk drive. Double sided, double density 500K unformatted, 40 track/side. Steel band drive system.  
Cat. C11901 **\$219**  
Case & Power Supply to suit  
Cat. X11011 **\$109**  
**M4855**  
Slimline 5 1/4" disk drive, double sided, double density, 96 track/inch, 2.0 Mbytes unformatted.  
Cat. C11905 **\$385**



### WELLER WTCPN SOLDERING STATION

The WTCPN Features:  
• Power Unit 240 V AC  
• Temperature controlled iron, 24 V AC  
• Flexible silicon lead for ease of use  
• Can be left on without fear of damaged tips!  
The best is always worth having.  
Cat. T12500 **R.R.P. \$129 SPECIAL, ONLY \$99**



**AA NICADS (ROCKET BRAND)**  
Save up to 50% off the regular price of \$2.80!  
1-9 **\$1.75** 10+ **\$1.65** 100+ **\$1.40**



**RITRON 19" RACK CASE**  
Tremendous Value! Dimensions 480(W) x 134(H) x 250(D)mm.  
Cat. H10415 **Normally \$47.95 SPECIAL, ONLY \$37.95**



**MAGNETIC BULK ERASER**  
The best and by far the quickest way to erase tapes, cassettes and computer disks! Reduces noise levels below recorders own erase head level. On/Off switch located in handle 240V AC operation.  
Cat. C14950 **Normally \$34.95 SPECIAL, ONLY \$29.95**



**DIGITAL SPEEDO/DIGITAL TACHO/SPEED ALERT**  
• Digital readout (LED) for both tach and speed.  
• Alarm with sound at variable preset speed.  
• Audible beeper and visual indication.  
• In built light indicator for night illumination.  
• Designed for 12 volt negative earth electrical systems.  
• Speed: 0 - 199kph  
• Tachometer: 0 - 9900kph  
• Speed alert: 40 - 120kph  
• Complete with mounting hardware.  
Cat. A15064 **Normally \$69.50 SPECIAL, ONLY \$55.60**



**ARLEC SUPER TOOL**  
A versatile 12V electric tool for...  
• Sanding  
• Engraving  
• Grinding  
• Polishing  
• Cutting  
• Drilling  
• Milling  
• Erasing, etc.  
**Features:**  
Operates on safe, low 12 volts from mains electricity via AC adaptor (supplied). Light and easy to handle with touch switch and lock for continuous running. High torque motor, 10,000 R.P.M. Can drill 2mm holes in steel. 2 year guarantee  
**Contents:**  
• 12V Super Tool  
• Plugpack AC adaptor  
• 1 spherical milling cutter  
• 1 wire brush  
• 1 grinding wheel  
• 4 drill bits, 0.6, 0.8, 1.0, 1.2mm  
• Set of 5 chuck collets  
• 6 eraser sticks  
• Instruction sheets  
Cat. T12300 **NORMALLY \$49.95 SPECIAL, ONLY \$44.95**



**MIDRANGE HORNS**  
Use these quality, all metal, Piezo tweeters for great top end sound in your band speakers, disco sound system, etc. Rated at 30 watts RMS, in a system they will handle over 100 watts RMS.  
Two sizes to choose from:  
Size: 4" x 10 1/2"  
Impedance: 8 ohms  
Rating: 30 watts RMS  
Response: 1.5kHz - 14 kHz  
Dimensions: 102 x 267 x 177mm  
Cat. C92082 **Normally \$49.95 This month only \$39.95**

Size: 3" x 7"  
Impedance: 8 ohms  
Rating: 30 watts RMS  
Response: 2kHz - 15 kHz  
Dimensions: 76 x 177 x 145mm  
Cat. C92084 **Normally \$29.95 This month only \$24.95**  
Dealers, OEM's, etc., phone (03) 543 2166 for wholesale prices



**SUPER HORN TWEETER**  
• Requires no crossover and handles up to 100W!  
• Sensitivity: 100dB/0.5m  
• Frequency Response: 3kHz-30kHz  
• Impedance: 8 OHMS  
• Size 96mm diameter  
Cat. C12102 **Normally \$17.95 SPECIAL, ONLY \$14.95**



**SUPER HORN**  
• Wide dispersion tweeter, handles up to 100W.  
• Sensitivity: 105dB/0.5m  
• Frequency Response: 3kHz-30kHz  
• Impedance: 8 OHMS  
• Size: 145x54mm  
Cat. C12103 **Normally \$17.95 SPECIAL, ONLY \$14.95**

**20% OFF ALL ARISTA PRODUCTS! AUDIO LEADS MIXERS CAR ACCESSORIES AUDIO PERIPHERALS etc**  
This applies only to our retail stores and is 20% off prices marked on them.

**SAME AS SUPPLIED IN ARCADE GAMES!**  
**4 WAY DIRECTIONAL JOYSTICK**  
Cat. X15635 **Normally \$29.95**



**FREE STANDING, FOLD UP MAGNIFIER**  
An economically priced "hands free" magnifier, lets you take care of all those tricky fine detailed jobs so often encountered in electronics, or any of many other practical uses such as home, work, hobbies etc.  
Cat. T12083 **Normally \$14.95 SPECIAL, ONLY \$12.95**



# PRE STOCK TAKE SALE!!



## CANON TYPE CONNECTORS

Cat. No.	Description	Price
P10960	3 pin line male	Was \$3.90 <b>NOW \$2.70</b>
P10962	3 pin chassis male	Was \$3.00 <b>NOW \$2.10</b>
P10964	3 pin line f. male	Was \$4.20 <b>NOW \$2.95</b>
P10966	3 pin chas. f. male	Was \$4.50 <b>NOW \$3.15</b>



## DIP SWITCHES

Cat. No.	Description	Was	Now
S13402	2 Way	\$1.50	\$0.75
S13404	4 Way	\$1.70	\$0.85
S13405	5 Way	\$1.90	\$0.95
S13406	6 Way	\$2.30	\$1.15
S13407	7 Way	\$2.40	\$1.20
S13408	8 Way	\$2.50	\$1.25
S13410	10 Way	\$3.00	\$1.50



## SCOPE 60W SOLDERING SYSTEM

- Infinitely adjustable temp. 200 C to 470 C. Sliding control selects desired tip temperature (LED readout monitors tip temp.)
- Safety holder features ceramic burn-proof bush and can be converted to left-hand-side.
- Soft and cool hand grip in pliable rubber.
- Screw type connector prevents accidental plug removal and guarantees solid contacts.
- Temperature lock allows production supervisors to control soldering temperatures.
- Anti seize tip retention device reduces risk of thread seizure by removing locking nut to cooler end of barrel.
- Optional 30W soldering pencil is available for finer work.

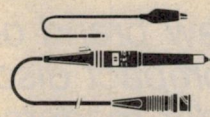
Cat. T12900 Normally \$159  
**NOW \$149**



## PANEL METERS GALORE!

We have a great range of panel meters at great prices!

Cat. No.	Description	Price
Q10500	MU45 0-1mA	12.50
Q10502	MU45 50-0/50uA	12.50
Q10504	MU45 0-100uA	12.50
Q10510	MU45 0-5A	12.50
Q10518	MU45 0-1A	12.50
Q10520	MU45 0-1A	12.50
Q10525	MU45 0-20V	12.50
Q10530	MU52E 0-1A	14.50
Q10533	MU52E 0-5A	14.50
Q10535	MU45 VU PMeter	14.95
Q10538	MU65 0-50uA	16.95
Q10540	MU65 0-1mA	16.95
Q10550	MU65 0-100uA	16.95
Q10560	MU65 0-20V	16.95



## BESWICK 88100 PROBE SET

CONTAINS: Compensated probe lead with...

- Detachable 6 inch earth lead
- Retractable hook
- IC test tip
- Tip insulator
- BNC adaptor
- Trimming tool

### SPECIFICATIONS:

Bandwidth: 10:1 position .250MHz at -3dB into 20 pF

Rise Time: 10:1 position less than 1.4ns nominal

Switch Function: (a) 10:1 attenuation +/- 1%, with oscilloscope of 1 Mohm input resistance

(b) 1:1 attenuation with bandwidth of 10 MHz approx.

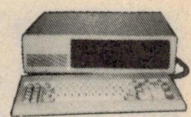
(c) Reference position, tip grounded via 9 Mohm, oscilloscope input grounded.

Input Capacitance: 16pF typical depending upon oscilloscope input capacitance.

Compensation Range: oscilloscopes of 15 to 60 pF input capacitance.

Working Voltage: 600V DC or peak AC

**\$34.95**



## IBM\* COMPATIBLES from \$899\*

Incredible deals to suit everyone including special package deals!

\*256K RAM, single drive, graphics, disk controller and printer cards.

IBM\* is a registered trade mark

**256K RAM:** Colour Graphics, Disk Controller Card, 1 parallel port, 2 disk drives and 3 months warranty. **only \$1,495**

**640K RAM:** Colour graphics, Multifunction Card, Disk Controller Card, 2 serial and 1 parallel ports, 2 disk drives and 3 months warranty! **only \$1,750**

**256K PACKAGE DEAL:** Includes Colour Graphics Card, Multifunction Card, Disk Controller Card, 2 serial and 1 parallel ports. A 120 C.P.S. printer and a monochrome monitor and 3 months warranty! **only \$1,850**

**640K PACKAGE DEAL:** Includes Colour Graphics Card, Multifunction Card, Disk Controller Card, 2 serial and 1 parallel ports. A 120 C.P.S. printer, a monochrome monitor and 3 months warranty! **only \$1,950**

\*IBM is a registered trademark.

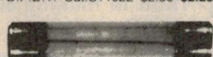


## CENTRONICS

Cat. No.	Description	Price
P12200	36 way plug IDC	<b>\$12.50</b>
P12201	36 way skt IDC	<b>\$13.50</b>
P12203	50 way plug IDC	<b>\$14.50</b>
P12204	50 way skt IDC	<b>\$15.50</b>
P12207	24 way solder plug	<b>\$12.90</b>
P12210	36 way solder plug	<b>\$ 9.50</b>
P12211	36 way sldr line skt	<b>\$15.95</b>
P12213	36 way sldr chss skt	<b>\$15.95</b>

## SPRING RETURN TOGGLE SWITCHES

S.P.D.T. Cat.	S11012	\$2.25	\$1.95
D.P.D.T. Cat.	S11022	\$2.50	\$2.25



## FUSE SPECIAL 3AG

Two values, 3 Amp and 1 Amp  
1-99 100-999 1000+  
**8¢ each 6¢ each 5¢ each**



## IC SPECIALS!

	1-9	10+	100+
4116	\$1.80	\$1.70	\$1.60
4164	\$2.95	\$2.75	\$2.50
2716	\$5.90	\$5.50	\$5.50
2732	\$6.25	\$5.95	\$5.50
2764	\$6.25	\$5.95	\$5.50
27128	\$6.95	\$6.50	\$6.25
6116	\$2.95	\$2.75	\$2.50
41256	\$6.95	\$6.50	\$6.00
6264	\$6.50	\$5.50	\$5.25
27256	\$11.50	\$10.50	\$10.00

## WORLD MODEM CHIP

Cat. U21614 Normally \$49.50  
**Save \$20, SPECIAL \$29.50**



## ECONOMY TRANSFORMERS

	1-9	10+
2155 240V 6-15V 1A		
Cat. M12155	\$6.75	\$5.95
2156 240V 6-15V 2A		
Cat. M12156	\$9.50	\$8.95
2851 240V 12-6V CT 150mA		
Cat. M12851	\$4.50	\$3.60
6672 240V 15-30V 1A tapped		
Cat. M16672	\$9.95	\$9.30
2860 240V 15V CT 250mA		
Cat. M12860	\$4.95	\$3.95



## BRAND NEW FANS

Not noisy pullouts! Stacks of uses in power amps, computers, hotspot cooling etc. Anywhere you need plenty of air.

240V 4" Cat. T12461 **\$12.95**  
115V 4" Cat. T12463 **\$12.95**  
240V 3 1/2" Cat. T12465 **\$12.95**  
115V 3 1/2" Cat. T12467 **\$12.95**

10+ fans (mixed) only \$10 each!



## BREADBOARDS

Cat. No.	Description	Price
P11000	100 Holes	\$ 2.75
P11005	640 Holes	\$10.75
P11007	640+100 Holes	\$13.00
P11009	640+200 Holes	\$17.50
P11010	1280+100 Holes	\$19.95
P11011	1280+300 Holes	\$32.50
P11012	1280+400 Holes	\$36.75
P11015	1920+500 Holes	\$57.50
P11018	2560+700 Holes	\$64.95



## HORWOOD ALUMINIUM CASES

H10382	3 x 4 x 2 inches	\$ 5.50
H10383	3 x 4 x 3 inches	\$ 6.50
H10384	3 x 4 x 4 inches	\$ 7.50
H10385	3 x 4 x 5 inches	\$ 7.95
H10386	3 x 4 x 6 inches	\$ 8.50
H10387	3 x 4 x 7 inches	\$ 9.50
H10388	3 x 4 x 8 inches	\$10.50
H10389	3 x 4 x 9 inches	\$10.95
H10390	3 x 4 x 10 inches	\$11.95



## HIGH EFFICIENCY RADIAL FIN HEATSINK

Black anodised with a thick base plate, this radial fin heatsink can dissipate large amounts of heat for maximum efficiency. Designed by Rod Irving.

105x30mm	Cat. H10520	\$ 3.50
105x75mm	Cat. H10525	\$ 3.50
105x100mm	Cat. H10529	\$ 4.90
105x140mm	Cat. H10534	\$ 6.50
105x150mm	Cat. H10535	\$ 6.75
105x170mm	Cat. H10538	\$ 7.95
105x195mm	Cat. H10542	\$ 9.90
105x200mm	Cat. H10543	\$ 9.90
105x225mm	Cat. H10546	\$10.50
105x300mm	Cat. H10549	\$12.00
105x600mm	Cat. H10560	\$24.95



## CORDLESS RECHARGEABLE SOLDERING IRON

- Built in solder point illumination
- Easy replacement of solder tip
- Protective stand which also functions as charging unit
- Sponge pad attach to stand
- Plug pack power adaptor
- Includes Nicad battery
- Instruction manual
- 12 months warranty

Cat. T12480 Normally \$59.95  
**SPECIAL, ONLY \$49.95**



## 20% OFF FERGUSSON TRANSFORMERS!

Applies only to our retail stores and to 'marked prices'



## PROFESSIONAL SERIES RACK MOUNTING CABINETS

These beautifully crafted rack cabinet boxes will give your equipment a real 1st class appearance.

- All aluminium construction.
- Removeable top and bottom panels.
- All dimensioning conforms to the International Standard.
- Natural or black finish.
- Ventilated lid.
- Deluxe brushed finish anodised front panel.

	Was	Now
H10401 Natural	\$49.50	\$43.50
H10402 Natural	\$59.50	\$56.00
H10403 Natural	\$69.50	\$63.50
H10411 Black	\$59.95	\$57.50
H10412 Black	\$69.95	\$65.00
H10413 Black	\$79.95	\$75.00



## ARLEC SUPER TORCH

A sophisticated rechargeable torch ideal for use in and around the home, the car, the boat, etc.

### FEATURES:

- Powerful built-in Nicad batteries.
- Reflector head swivel through 90 degrees.
- 3 position switch gives on/off, and dim.
- Indicator lamp when recharging.
- Charges from mains, electricity or from a car battery.
- Supplied complete with (A) SEC approved battery charger (B) Plug and cord for car lighter socket.
- (C) Handy charging bracket with fixing screws.
- 12 months guarantee.

Cat. A15055 Normally only \$44.95  
**SPECIAL, ONLY \$39.95**



## COMPUTER CABLE

CIC6 6 conductor computer interface cable. Colour coded with braided shield.

(to IE422 specifications). Copper conductor 6 x 7/0.16mm. 1-9 metres 10+ metres  
**\$2.50/m \$2.20/m**

CIC9 100 9 conductor computer interface cable. Colour coded with mylar shielding. 9 x 7/0.16mm. 1-9 metres 10+ metres  
**\$2.95/m \$2.75/m**

CIC12 12 conductor computer interface cable. Colour coded with mylar shielding. 12 x 7/0.16mm. 1-9 metres 10+ metres  
**\$3.50/m \$3.20/m**

CIC16 16 conductor computer interface cable. Colour coded with mylar shielding. 16 x 7/0.16mm. 1-9 metres 10+ metres  
**\$4.50/m \$4.10/m**



## LOGIC PROBE 3800A

Features 20MHz memory, TTL/CMOS operation. Normally \$29.50  
Cat. Q11272 **\$34.50**

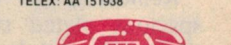
**SPECIAL, ONLY \$29.30**



## ROD IRVING ELECTRONICS

425 High Street, NORTHCOTE, 3070 VICTORIA, AUSTRALIA  
Phone (03) 489 8866  
48 A Beckett St, MELBOURNE, 3000 VICTORIA, AUSTRALIA  
Ph. (03) 663 6151

Mail Order and correspondence: P.O. Box 620, CLAYTON 3168  
TELEX: AA 151938



## MAIL ORDER HOTLINE (03) 543 7877 (2 lines)

POSTAGE RATES  
\$1-\$9.99 \$2.00  
\$10-\$24.99 \$3.00  
\$25-\$49.99 \$4.00  
\$50-\$99.99 \$5.00  
\$100-\$199 \$7.50  
\$200-\$499 \$10.00  
\$500 plus \$12.50

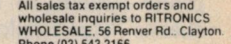
This is for basic postage only. Comet Road freight, bulky and fragile items will be charged at different rates.

Certified Post for orders over \$100 included "free"

Registered Post for orders over \$200 included "free"

All sales tax exempt orders and wholesale inquiries to RITRONICS

WHOLESALE, 56 Renner Rd, Clayton, Phone (03) 543 2166



Errors and Omissions Excepted

NOTE: ALL "20% OFF" ARE APPROX. ONLY



## ADC CD-100X compact disc player

*ADC is a new brand on the Australian market as far as compact disc players are concerned although older readers will recall the popular ADC cartridges of about a decade ago. The ADC brand is now applied to a range of graphic equalisers and this compact disc player, which is made in Japan.*

As with many CD players on the market now, the ADC CD-100X is not unique in the slightest. It is finished in black with grey lettering and it is a front drawer loading machine. Dimensions are 341mm wide, 293mm deep and 88mm high and weight is 3.3kg.

The control panel for the machine has a fairly busy appearance due to the number of labels but the control line-up is fairly standard. There are 10 pushbuttons in all, with functions as follows: Play/pause, Stop/open, Skip forward, Skip back, Forward, Reverse, Memory Enter/set, Memory clear, Repeat and Time remaining. As well, there is a power pushbutton on the left-hand side of the panel, just below the disc drawer.

The rear panel is bare apart from the RCA output terminals, the mains voltage selector and the power cord. The machine is labelled as being "double-insulated" and is fitted with a sheathed two-core flex and moulded Australian-style 2-pin plug.

Removing the top cover reveals a spacious plated steel chassis substantially occupied by a large PC board. There are also vertically mounted boards behind the front panel and on the right-hand side of the chassis. Most of the circuitry is contained in three large integrated circuits, made by Sony and Hitachi. The ADC is a 16-bit machine with a single digital-to-analog converter and a seventh-order passive filter.

The CD player mechanism has a very pliant suspension and has an interesting clamp system on the underside of the chassis. This employs a plastic clamping

piece and two screws, plus a nylon locking screw.

Transit clamping screws for most compact disc players are a nuisance because they are bound to be lost once they are removed for playing. The ADC player solves this problem by providing a new position for the clamp and transit screws when in the playing mode.

In this way, if you have to pack up the player for transport, you don't have to search for the screws and clamp. They are right there on the chassis, together with instructions stamped into the metal. Other CD player manufacturers would do well to come up with a similar solution.

When the player is turned on, the small vacuum fluorescent display shows a "1" to indicate that it is alive. Then pressing the Play/pause or Stop/open button causes the drawer to slide open ready for a disc. Pressing one of the same two buttons then causes it to close, ready to be programmed for play. Alternatively, if Play is pressed the

music will start almost immediately.

It is also possible to push on the disc drawer to make it retract, a good feature which prevents mechanical abuse.

Playing features of the ADC are fairly standard for most machines. The only facilities it really lacks are audible fast forward and reverse, and index programming which most people don't use anyhow.

### Performance

Most of our tests on the ADC CD-100X were made with the Technics SH-CD001 and an AWA noise and distortion meter which has a steep rolloff 20kHz filter. This latter feature is important in making some of the measurements.

Frequency response turned out to be very flat, even for a CD player, with virtually no deviation at all from 20Hz to 5kHz. Above 5kHz there is a very slight rise in the response to +0.6dB at 15kHz and then dropping back to 0dB at 20kHz. Many players are down by as much as 2dB at 20kHz so the ADC machine stands out for this parameter alone.

Separation between channels was also very good with figures of 92dB at 100Hz, 93dB at 1kHz and 80dB at 10kHz (worse channel figures in each case).

In the same vein, linearity test results were outstanding with no error at -70dB, +0.2dB at -80dB and +2dB at -90dB. We were able to measure these





results in spite of a residual 44.1kHz signal at -78dB with respect to 0dB level. (We were able to remove this from the measurements with the distortion meter's 20kHz filter.)

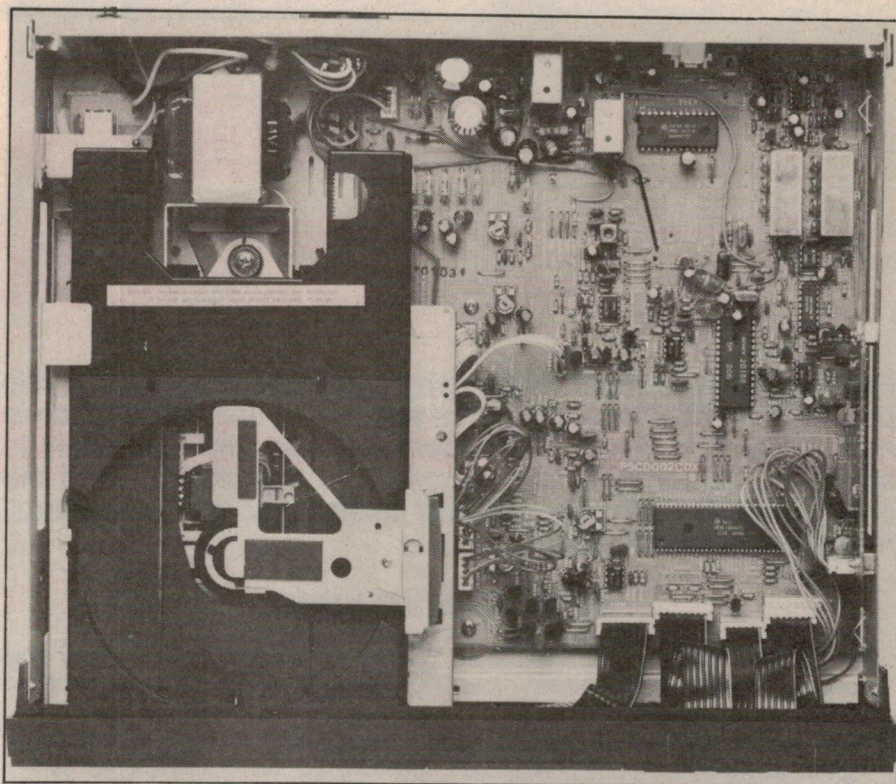
Total harmonic distortion results were also very good with the results being around .006% for frequencies up to 1kHz. Above this point the distortion rises gradually until it reaches .027% at 15kHz. Above there the THD figure rises more rapidly to 0.3% but these figures are clouded by the 44.1kHz sampling artefacts in the distortion products.

Checks on the tracking performance of the machine using the Philips No 4A test disc gave it a clean bill of health. It sailed through all the tests with not so much as a hiccup. And the machine also managed to load and play most of the tracks on our badly scratched sample disc which is a pretty good result. Some machines can't even load the contents of this particular disc, let alone play any of the tracks.

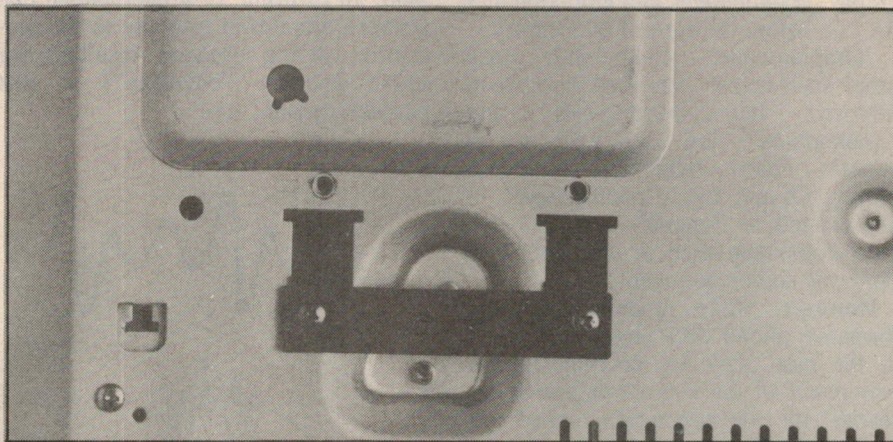
Nor was the ADC overly susceptible to shock and jarring. We judged that it was quite immune to sideways jarring but somewhat less so to jarring the top panel of the case. Overall though, it was good.

Having said all that, the machine sounds particularly good too. Compared with many other machines, which have that slight rolloff at the top end, the CD-100X has a very clean and extended top end. We have to recommend it as a very good all round machine.

Recommended retail price of the ADC CD-100X is \$599.00. For further information and demonstration, contact hifi stores, Jaycar Electronics stores or the Australian distributor, Concept Audio Pty Ltd, 98 Old Pittwater Road, Brookvale, NSW 2100. Phone (02) 938 3700. (L.D.S.)



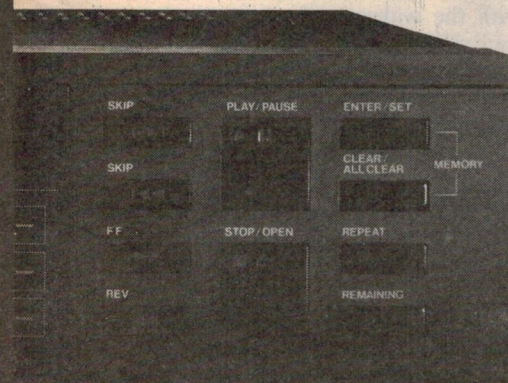
Inside the CD-100X — most of the circuitry is mounted on a large PC board.



The suspension clamping system employs a plastic clamping piece and two screws, plus a nylon locking screw (top left).

## SPECIFICATIONS

Frequency response .....	±0.8dB (10Hz to 20kHz)
Total harmonic distortion .....	.004%
Signal-to-noise ratio .....	96dB or more
Channel separation (1kHz) .....	90dB
Output level .....	2V RMS at 600 ohms
D-A conversion .....	16 bit linear
Filter .....	passive 7th order
Error correction .....	CIRC dual system
Dimensions (W x H x D) .....	341 x 88 x 293mm
Weight .....	3.3kg





# CARTRIDGES & STYLI EXPLAINED

For fifty years or more, phonograph records have been a vital part of domestic sound systems and, while their dominance is now threatened by the digital compact disc, they are likely to be around for quite a few years yet. In this chapter, and the one to follow, we examine the technology of conventional records and record players.

by NEVILLE WILLIAMS

In practical terms, the so-called "black disc" has a longer history than any other item in a domestic sound system. The basic principle dates back to pioneers like Edison, Berliner, Bell and Tainter, who were offering their phonographs, gramophones and graphophones for sale before the turn of the century.

"Graphophone", along with many other such names, has long since been forgotten but "phonograph" and "gramophone" are still with us as generic nouns signifying a record player. Of the two, "phonograph" — abbreviated to "phono" — is the one most commonly used in the context of domestic audio equipment.

However, while modern, high-performance phono decks have their roots in the past, they are nevertheless the end result of decades of dedicated research and development, topped off with a significant content of space-age precision and technology.

Before discussing the major components in a modern, quality phono deck, it may be helpful to look at the record groove itself — a source of wonderment to many: how can a groove in the surface of a disc capture and store sound, especially sound as complex as that of a symphony orchestra?

### The record groove

The answer to that question follows on from the closing paragraphs of Part 1, dealing with sound waves. We pointed out there that multiple pressure waves from a sound source, whether

simple or complex, add up to a single pressure resultant at any one instant at any given point in a sound field.

The resultant varies continuously, depending on the instantaneous sum of the individual components. In a sound-field, an eardrum, or a microphone diaphragm, vibrates in response to the constantly varying pressure resultant (or sound pressure "envelope") at that particular point.

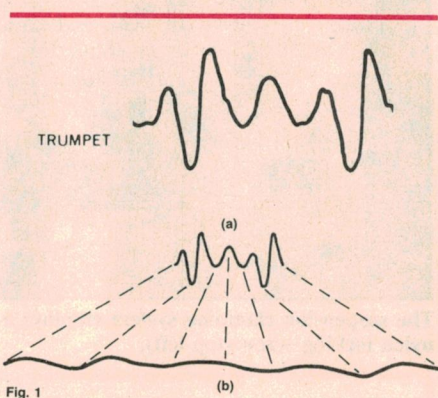


Fig.1: (a) represents a few cycles from the sound pressure envelope of a trumpet; (b) suggests how the same waveform might look as the segment of a groove in a laterally recorded disc.

Fig.1(a), reprinted from this earlier section, depicts a few cycles from the sound pressure envelope of a trumpet. Imagine this being picked up by a microphone and fed to a recording head

inscribing a lateral (sideways modulated) groove in the surface of a master disc.

Fairly obviously, the groove deviations would be essentially proportional to those of the source signal but, to be physically traceable by a playback stylus, they need to be suitably adjusted in amplitude and elongated by virtue of groove speed, more or less as depicted in Fig.1(b).

When that same fragment of groove is replayed, the original signal (1a) will be recovered — hopefully along with the rest of the trumpet solo — to be fed to an amplifier and loudspeakers and enjoyed by all!

In short, a record groove can logically be regarded as a graph of a sound pressure envelope, not drawn on paper, but inscribed as a wiggly spiral, hundreds of metres long, in the surface of a disc. The more complex the source signal, the more complex the pattern of deviations in the groove, and therefore the more complex the sound pressure pattern ultimately radiated from the loudspeakers.

### Groove size, shape

In the era of mechanical reproduction, the groove and "needle" geometry had to be sufficiently rugged to provide adequate drive for an acoustic diaphragm and horn system. However, with the widespread adoption of "electric" pickups and amplifiers in the '30s, a less cumbersome system became possible, although it did not actually emerge until after the war.

Fig.2 indicates the relative size of the "coarse groove" geometry (a) used in 78rpm shellac discs and (b) that adopted for "fine groove" LP vinyl records.

Coarse grooves were originally played with steel "needles" designed to wear to the shape of the groove while playing. Towards the close of the era, they gave way to "permanent" styli with a hemi-



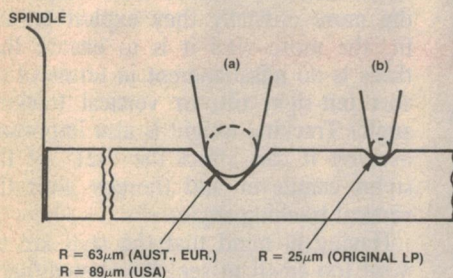


Fig. 2

Fig.2: (a) depicts a "coarse" (78rpm) groove being played by a hemispherical jewel tipped stylus; (b) indicates the relative geometry of the groove and stylus adopted for the original LP discs.

spherical jewel tip, as shown, commonly ground to a radius of  $63\mu\text{m}$  (0.0025in).

By contrast, fine groove technology called for a tip radius of (initially)  $25\mu\text{m}$  (0.001in) and a much lower tracking force (or weight) on the stylus — down from 30 grams or more to five grams or less.

Apart from the advantage of longer playing time and lower noise, the new standards encouraged progressive refinement of both recording and replay equipment, in terms of wider frequency response, lower distortion and greater dynamic range. Further impetus was provided by the subsequent introduction of stereo recording and playback.

### 45/45 stereo system

And that raises the question as to how it is possible to record two separate audio signals in the one groove, representing the left and right stereo channels.

Fig.3 depicts the situation with ordinary mono lateral recording. The cutting stylus is driven from side to side (a) by the incoming audio signal such that the groove (b) deviates to the left and

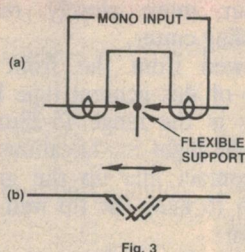


Fig. 3

Fig.3: In a mono recording, groove modulation is purely lateral, the depth of the groove remaining substantially constant. Compare this diagram with Fig.4f (below).

right of its unmodulated path, the depth remaining substantially constant.

For mono playback, the head and arm must be free to follow slight undulations or eccentricities in the disc or turntable but the stylus system itself needs only to sense lateral groove deviation, generating a single, mono output signal as it does so.

By contrast, stereo LP recording and playback, introduced in the late '50s,

uses the so-called "45/45" configuration. As indicated in Fig.4(a), it involves twin drive systems for the cutting stylus, each mounted at 45-degrees to the horizontal, and a complementary 45/45 mechanism in the playback head.

If signal drive is confined to the left channel (b) only the inner wall of the groove is modulated. Conversely, signal to the right channel only modulates the outer wall of the groove (c).

With different signals applied simultaneously to both channels, different modulation patterns appear on the respective walls. Depending on the instantaneous relationship of the drive signals, the stylus may move sideways, upwards or downwards, with the groove being modulated both laterally and vertically (d).

For stereo playback, the process is reversed, with the pickup stylus assembly responding to modulation on either or both walls and generating separate left-channel and right-channel signals.

### Stereo-mono compatible

In practical recording situations, sound sources near the centre of the stereo sound field may produce similar signals in both channels, particularly at lower frequencies. Depending on the phase relationship of the cutter drive circuits, these "common mode" signals could cause the cutter to move either vertically (e) or horizontally (f).

Standard recording practice requires that "common mode" or "centre stage" signals produce lateral deflection of the cutter (f) equivalent to normal mono (Fig.3b). This ensures a basic compatibility such that a mono cartridge can play a stereo disc, and vice versa, the signal content being normal in each case, except for the absence of stereo information.

(Note that a mono cartridge, used to

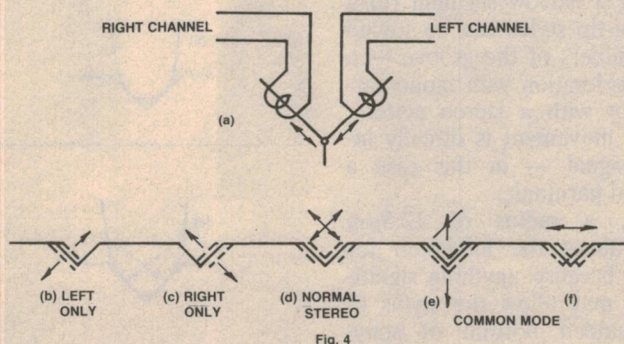
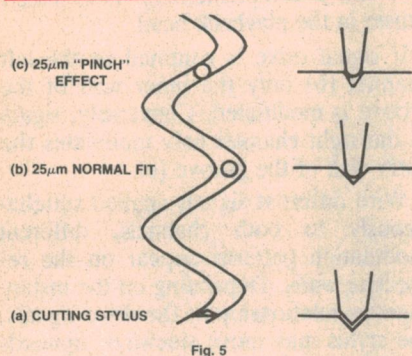


Fig. 4

Fig.4: With a 45/45 stereo system (a), vertical as well as lateral modulation is evident in (b), (c) and (d). A special situation arises with identical signals in both channels, resulting in (e) and (f).



# Cartridges & styli



**Fig.5:** When a cutting stylus (a) is moving sideways, it cuts a narrower groove, forcing a spherical tipped stylus (b) towards the top of the groove as at (c) — described as “pinch” effect.

play a stereo record, should have sufficient vertical compliance in the stylus suspension to allow it to track the vertical modulation, and so avoid damage to the groove.)

## Playback styli

In the '50s, the task of mass producing affordable, properly ground and polished jewelled styli, with a 25µm tip radius, was a daunting one but manufacturers learned to cope, first with sapphire and later with diamond, which is harder and more wear resistant.

With the introduction of stereo, and consequent closer attention to groove shape, it became desirable to use a tip radius smaller than 25µm, partly to ensure better tracking of fine (high frequency) groove modulation and partly in an effort to counteract “pinch effect”, which can occur where the groove narrows, during lateral deviation of the wedge-shaped cutting stylus. (Fig.5a).

In traversing a narrow segment (c) a 25µm spherical-tip stylus can be forced up on the shoulders of the groove — a secondary consideration with mono cartridges but not with a stereo system, where vertical movement is directly interpreted as signal — in this case a spurious second harmonic.

In practice, a radius of 12.5µm (0.0005in) is about the minimum for spherical tips, because anything significantly smaller may allow the stylus to touch the rounded bottom of some grooves, resulting in noise due to debris, and/or distortion due to “skating” effects. Even 12.5µm is suitable only for cartridges able to operate with a very

low tracking weight, because of accelerated tip wear and the risk of compressing fine groove serrations — described as “dynamic” distortion.

Nowadays, as a more forgiving figure for modestly priced spherical tips in modestly priced cartridges, most manufacturers favour a minimum radius of about 17.5µm (0.0007in).

## Multi-radius styli

Seeking a more effective answer to both pinch effect and tracking problems, designers subsequently came up with the bi-radius or “elliptical” concept — the first step towards a 3-dimensional contour more closely resembling a recording cutter.

Viewed from the front (Fig.6a) a stylus of this general type has a major radius in the range 15-23µm, but with possible slight modifications to increase the contact line up the groove walls, and/or to keep the tip well clear of the bottom.

From above, the section within the groove is a slim oval (Fig.6b) with shoulder radii in the range 2.5-5µm, resulting in a stylus less prone to pinch effect and also better able to follow high frequency groove modulation — therefore exhibiting lower “tracing” distortion.

To take proper advantage of the elliptical contour, manufacturers adopted the practice of so arranging the stylus suspension that the axis of stylus movement and the alignment of the stylus shoulders was tilted forward relative to the vertical by a uniform 15 degrees — a figure later amended to 20 degrees. This is now an industry standard for the so-called “vertical tracking angle”, ob-

served by cartridge and record manufacturers alike.

The “Shibata” stylus, especially devised for the abortive 4-channel CD-4 system, pioneered the technology for a whole range of even more specialised styli, with small radius shoulders but a front profile intended to fit more snugly against the sides of the groove, as illustrated in Fig.6c.

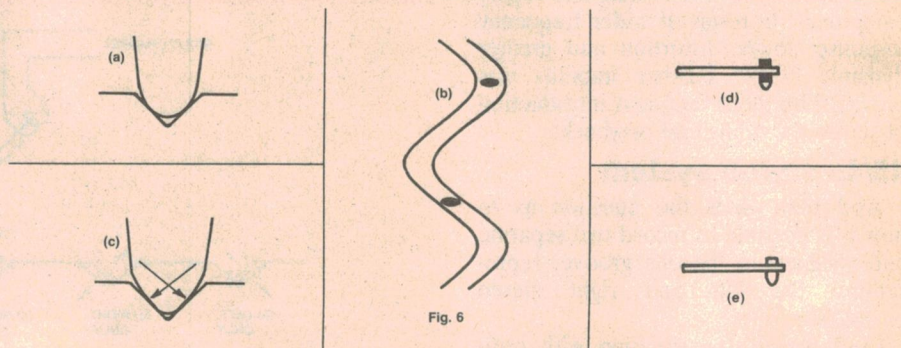
High performance styli of this general type are variously described as “line contact”, “lineal contact”, “fine line”, “contact line”, &c, and they may be produced in diamond tipped form (Fig.6d) or as “nude” or “naked” (whole) diamonds (6e). But they have one thing in common:

The more specialised their shape and the more critically they exploit groove fit, the more vital it is to ensure that there is no misalignment in terms of either left-right tilt, or vertical tracking angle. Tracking weight is also important because it can affect the “set” of the stylus cantilever and thereby alter the vertical tracking angle.

Having in mind that the styli are almost too small to see, it is not difficult to appreciate that such requirements place extreme demands on the precision of the cartridge and playing arm, and on the operation of the mechanism as a whole. It is on this kind of precision that the performance of a top quality record player depends.

## Frequency characteristic

In the recording process, the groove is normally inscribed in the surface of the master disc by a magnetic cutting head, as implied in Figs.3&4. The signal(s) to be recorded are fed to windings which are part of a magnetic circuit in the head and the resulting field, varying in response to the audio signal(s), causes the stylus to vibrate in sympathy,



**Fig.6:** An elliptical stylus (a) largely overcomes pinch effect (b). Shibata or similar styli (c) provide a longer contact area with the groove walls. Styli may be jewel tipped only (d) or “nude” (i.e. whole) diamonds (e).



# MICROPHONE OF THE MONTH

...A CLOSE LOOK  
AT ONE OF OUR 100



**SM5B**  
UNI-DYNAMIC



**SM83**  
OMNI-  
CONDENSER



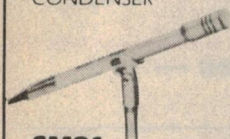
**SM7**  
UNI-DYNAMIC



**SM82**  
LINE LEVEL  
CONDENSER



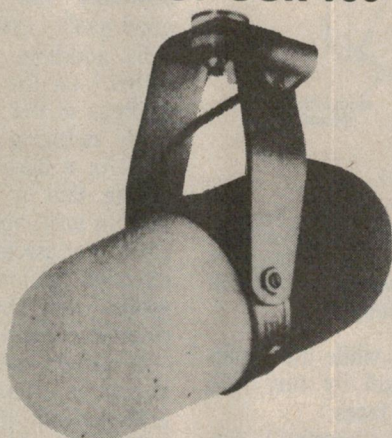
**SM91**  
HALF-CARDIOID  
CONDENSER



**SM81**  
UNI-CONDENSER



**SM87**  
SUPER-CARDIOID  
CONDENSER



## SM5B

### Studio Cardioid Dynamic

#### Gives you new freedom in maneuvering booms

Specifically designed to provide maximum wind noise suppression during fast boom swings on television production and motion picture sound stages, or in outdoor locations. Highly effective layer of acoustically-transparent dense foam minimizes wind sounds while providing superb pickup of program material.

#### Extremely "Forgiving"

An outstandingly uniform cardioid polar pattern—in all planes, and all frequencies—results in singular lack of off axis coloration, even at the low end. Gives the performer complete freedom of movement.

#### Super Natural Sound

Smooth, wide range frequency response with a controlled presence rise makes it ideal for vocal pickup, scoring assignments, and accurate voice reproduction. (Radio DJ's love it.)

Humbucking coil, balanced circuit, and absence of transformers or response-correcting inductors suppress electrical noise due to hum fields. One of a kind... From Shure, of course.

Write:  
Audio Engineers P/L 342 Kent St.  
Sydney, 2000 (02) 29 6731  
Audio Engineers Qld. (07) 44 8947  
Marketec (WA) (09) 242 1119

Sound of the professionals

# SHURE®

# AR2002<sup>WORLD'S FIRST</sup>

- CONTINUOUS COVERAGE
- THREE MODE SCANNER
- COMMUNICATIONS RECEIVER



#### Features:

- 25-1300 MHz
- NFM, WFM, AM
- 20 CH Memory
- Clock
- Priority CH
- S-Meter
- PLL Synthesizer
- Many other features

**NEW**

## Personal 2-way radio here at last! "EMTRON ACE"

A QUALITY 40-CH HIGH POWER UHF CB  
HAND-HELD TRANSCEIVER • DESIGNED FOR  
AUSTRALIA DOC APPROVED.

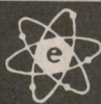
#### FEATURES:

- 40 Channel Operation
- High (2.6W) Low (0.5W) RF Output
- Offset for Repeater Operation
- Nicad Rechargeable Batteries
- Illuminated Dial for Night Operation
- Small in Size — Big in Performance

#### APPLICATIONS:

- Farming
- Fishing, Boating, Hunting, Bushwalking
- Bush Fire Control
- AG Shadows
- Security
- Construction sites
- Car rallies
- Crowd control and many others

DEALER ENQUIRIES WELCOME



# EMTRONICS

NSW: 94 Wentworth Ave, Sydney, NSW. 2000.

Ph: (02) 211 0988

VIC: 288-294 Queen St. (Pff Lt. Lonsdale St.) Melbourne,  
Vic. 3000. Ph: (03) 67 8131 or 67 8551



# Cartridges & styli

modulating the groove as it is inscribed.

By nature, a magnetic recording head exhibits what is termed a "constant velocity" characteristic, such that the amplitude of the groove modulation tends to vary inversely as the signal frequency. Double the frequency and the amplitude is halved; halve the frequency and the amplitude doubles.

Because this would lead to excessive amplitude at low frequencies and inadequate groove modulation at high frequencies, engineers normally modify the frequency response of the head drive amplifier(s) to counteract the constant velocity characteristic and so achieve a convenient level of modulation at all frequencies.

As a result all phono recordings have an intrinsic frequency characteristic which has to be taken into account in the replay system. A complete article could be devoted to the subject of recording characteristics used over the years but, fortunately, the vast majority of LP recordings conform to the "RIAA" (Record Industry Association of America) characteristic, either in its original or a slightly modified form.

In fact, a recording head compensated to the RIAA characteristic exhibits something fairly close to a "constant amplitude" response, producing a groove deviation which remains substantially constant with frequency. We shall be saying more about this later.

## Phono cartridges

In the 78rpm era, the transducer components were often built into the actual pickup arm but, with the greater precision and higher expectations associated with fine groove records, the preferred approach was to mount them in a separate cartridge.

Over the years, phono cartridges have been designed around a variety of basic principles — Capacitor, FM, Magnetostriction, Optical, Semiconductor, Strain gauge, &c. but, while interesting in themselves, they attracted only limited support. Nowadays, the vast majority of cartridges fall into two main categories: piezo and magnetic.

## Piezo cartridges

"Piezo", short for "piezoelectric", exploits the characteristic of certain (notably crystalline) substances to produce a voltage between opposite faces when subjected to pressure or stress. In a phono cartridge, the stress is provided

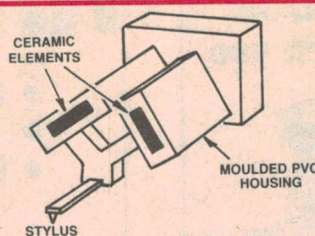


Fig. 7

**Fig.7: The physical construction of a typical ceramic cartridge — able to be mass produced reliably and cheaply but not well suited to true hifi requirements.**

by the stylus assembly, while the resultant voltages are sensed by tiny foils bonded to the relevant faces.

Early model piezo ("crystal") cartridges used tiny slabs of crystalline Rochelle salts. They were superseded by cartridges using specially processed barium titanate ceramic elements. While their output level was somewhat lower, they were much more durable, particularly at high levels of temperature and humidity.

Fig.7 illustrates one of many possible configurations for a stereo "ceramic" cartridge. A flexible suspension supports the stylus assembly, permitting the stylus to track the modulation while, at the same time, applying stress to the ceramic elements.

By nature, a piezoelectric cartridge exhibits a constant amplitude response, its output voltage being proportional to the amount of deflection, irrespective of frequency. Since, as noted earlier, an LP recording is recorded to a substantially constant amplitude characteristic,

a ceramic cartridge will recover from it a substantially "flat" signal.

This makes it possible for a ceramic cartridge to be used without a frequency compensating preamplifier — but only in medium fidelity equipment. "Substantially" flat is not flat enough for a good quality system!

In addition, the need to perform "work" on the ceramic elements adds stiffness to the stylus movement, effectively reducing its "compliance". This calls for a fairly high playing weight to ensure that it tracks the groove and that, in turn, necessitates a more rugged stylus and assembly, leading to a higher effective tip mass, poorer transient response and the added likelihood of resonance effects in the passband.

Designers have made resolute attempts to compensate or otherwise upgrade crystal and ceramic cartridges to full hifi standards but without notable success. They remain a convenient medium-fi component although, even in that area, they are facing increased competition from mass produced magnetic types.

## Magnetic cartridges

Essentially, magnetic cartridges involve a small permanent magnet, the components necessary to form a magnetic circuit, and the coils across which the signal voltages are developed.

Depending on the design, movement of the stylus may be transmitted to the magnet (MM, moving magnet system), to some element of the magnetic circuit (VR, variable reluctance) or to the coils (MC, moving coil). All have been used successfully in good quality cartridges.

All magnetic cartridges exhibit a constant velocity characteristic, such that the output signal voltage tends to vary

## MM & VR magnetic phono cartridges — typical parameters #

Weight of cartridge .....	3.5*-11gm
Equiv. stylus tip mass .....	0.3*-0.7mg
Rated frequency response .....	20Hz-20kHz/30kHz*
Freq. response tolerance .....	± 1dB*, ± 3dB.
Output, 1000Hz, 5cm/sec .....	2.0mV-5.0mV*
Channel separation, 1000Hz .....	20dB-30dB*
Channel balance, 1000Hz .....	1.5dB*-2.0dB
Dynamic compliance, 10Hz .....	20-40* µm/mN
Recommended tracking force+ .....	10mN (1.0g)*-20mN
Load resistance+ .....	47k-100k ohms
Total shunt capacitance+ .....	200pF*-500pF

# MC cartridges also, except for output impedance & voltage.

+ Follow manufacturer's recommendation.

\* Denotes preferred end of quoted range.



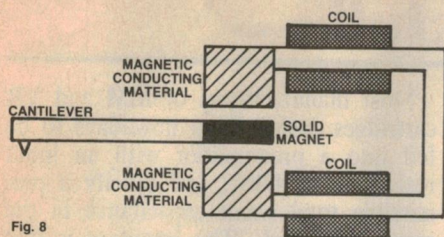


Fig. 8

**Fig.8: Illustrating the moving magnet system.** For simplicity, only one pair of coils, for one channel, is shown. The induced magnet system is an elaboration of this same principle.

directly with frequency: double the frequency and the output tends to double; halve the frequency and the output is likewise halved.

When playing an LP record, with its substantially constant amplitude characteristic, a magnetic cartridge will generate a signal with a rising treble and a falling bass response. Magnetic cartridges therefore need to be used with a compensated preamplifier — in fact, one exhibiting a response which is the converse of the RIAA recording characteristic. (See Fig.2b&c in the previous chapter).

## Moving magnet system

Fig.8 depicts, in highly simplified form, the operation of an MM (moving magnet) type cartridge. A tiny magnet, mechanically coupled to the stylus cantilever, moves physically in the space between the pole faces, modulating the magnetic field and inducing signal voltage in the associated coils.

In a stereo cartridge, there are actually four pole faces and two magnetic circuits set at 90-degrees to each other and at 45-degrees with respect to the horizontal, respectively sensing modulation from the left and right groove walls.

The size of the moving magnet involves a compromise between output signal level, and the degree by which a more powerful (and heavier) magnet would increase the effective moving mass at the stylus tip. This could limit the response to transients and, as well, aggravate mechanical resonance effects.

The "induced magnet" concept offers a way around this difficulty by using a deliberately small or virtual moving magnet but supplementing its field with a powerful fixed magnet. While minimising the original problem, however, an extra magnet can add to the all-up

weight of the cartridge, complicating arm resonance effects in the sub-bass region.

## Variable reluctance

Fig.9 closely resembles Fig.8 but illustrates the variable reluctance approach, as expressed in Ortofon's VMS (variable magnetic shunt) type cartridge.

In broad terms, reluctance can be regarded as the equivalent in magnetic circuits of electrical resistance, limiting magnetic flux. An air gap in a magnetic circuit introduces considerable reluctance; modifying the air gap in a periodic fashion will vary the reluctance and

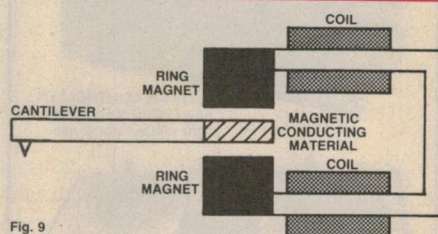
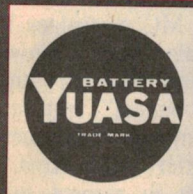


Fig. 9

**Fig.9: In a variable reluctance cartridge, the magnet and coils are fixed but movement of part of the magnetic circuit modulates the magnetic flux, inducing a voltage across the coils.**



# Sealed lead acid & nickel cadmium rechargeable batteries

**MAINTENANCE FREE**



**COMPLETE RANGE OF BUTTON CELL STACKS**

assembled in Australia to customers specifications.



I.E.I. (AUST.) PTY. LTD.

15-17 Normanby Road, Clayton, Vic. 3149 Phone (03) 544 8411  
31 Phillips Street, Thebarton, S.A. 5031 Phone (08) 352 2066  
248 Johnston Street, Annandale, N.S.W. 2038 Phone (02) 692 0999



## Cash More Sound



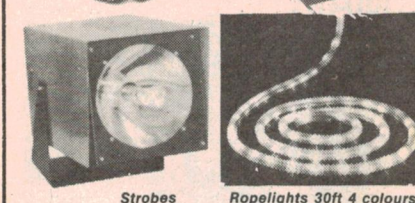
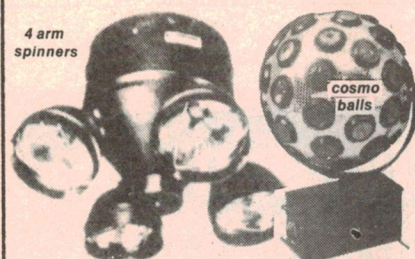
**SOUND SYSTEMS  
DISCOTHEQUE'S & LIGHTING**



**STAGE CONTROLLER**  
4 X 1000 watt sound to  
light chaser inbuilt mic



**SOUNDCENTRE DISCOTHEQUE CONSOLE**  
200 X 200 watt inbuilt amplifiers  
JVC — National D/Drive T/Tables —  
cassette deck — 2 mic inputs W/V/oride  
tape & aux in-out carpet covered.



- \* 18-lamp bar rotator
- \* projectors \* fuzz lites
- \* fog machines \* scanners
- \* colourer par 30 lamps
- \* light boxes \* mics-stands

**Manufacturers of speaker  
cabinets discotheque consoles  
— rope lights chasers etc.**

For your entertainment needs contact: —

**CASH-MORE SOUND**

or visit the showrooms:

354 LIVERPOOL RD, ASHFIELD, NSW 2131  
TELEPHONE: (02) 798 6782 TLX: AA74549

**REHERSAL STUDIOS AVAILABLE  
HIRE — SALES — INST — SERVICE**

## Cartridges & styli

therefore the flux, inducing voltages across the associated coils.

In the base of the VMS cartridge, a thin-walled armature of conducting material, attached to the cantilever, modifies the magnetic field created by a ring magnet, generating a signal voltage across the coils. Ortofon claim that their tiny tubular armature has less mass than a moving magnet, leading to improved high frequency and transient response.

Alternatively, in their MMC (Moving Micro Cross) variable reluctance cartridges, Bang & Olufsen (B&O) use a tiny flat armature attached at right angles to the end of the cantilever, and bridging the faces of four pole pieces on which are mounted the four coils.

### Resonance, loading, &c

The natural resonance of the stylus system in moving magnet and variable reluctance cartridges is usually somewhere in the range of 15-25kHz. In terms of ultimate performance, the higher figure is to be preferred but it comes at a price: exotic (and more costly) technology, involving both the cartridge and the associated player, and increased vulnerability to misuse.

In most affordable quality cartridges, a resonance somewhat below 20kHz is tolerated, but subject to both mechanical and electrical damping. Mechanical damping has to do with the design of the cartridge; electrical damping with the coils and how they are terminated.

Because the coils in a moving magnet or variable reluctance cartridge are fixed, they can involve a relatively large number of turns, in the quest for adequate output signal voltage. However, with a coil inductance of typically 500 millihenries consideration has to be given to the capacitance of the pickup output leads and the input capacitance and resistance of the associated pre-amplifier.

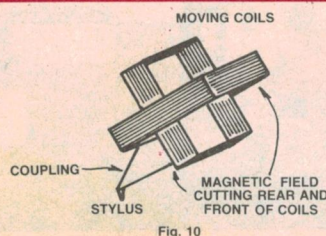


Fig. 10

Fig.10: At the heart of a moving coil cartridge is a pair of coils driven by the stylus. In many MC cartridges, the stylus and cantilever are not user replaceable.

Most manufacturers of MM and VR cartridges design them nowadays to be fed into a preamplifier with an input resistance of 47kΩ, and specify a permissible total shunt capacitance in the range 200-500pF. The intention is that the electrical and mechanical characteristics should complement each other to produce an acceptably flat treble response.

### Moving coil cartridges

At the heart of a moving coil cartridge is a pair of coils, as in Fig.10, to which is attached a cantilever and stylus. The coils are so positioned in a magnetic field that each one senses the modulation on a particular groove wall.

To minimise the moving mass, most MC cartridges use coils with a relatively small number of turns, resulting in low inductance, low impedance and only about one-tenth the output voltage of an MM or VR type cartridge.

With rare exceptions, MC cartridges cannot be fed successfully into the "Phono" sockets of a normal hifi amplifier. Early practice was to use them in conjunction with a special step-up transformer but the preferred method, nowadays, is to use a pre-preamplifier stage, either an outboard unit, or one built into the more deluxe amplifiers.

Over the years, MC cartridges have built up a virtual "cult" following, which credits them with a unique "sweetness" and "openness". In terms of published performance parameters, however, they differ little from the other types, except in respect to the output arrangements.

### Magnetic fields

Last but not least, two matters should be mentioned which are common to all magnetic cartridges.

Since they involve magnetic circuits and coils, they are sensitive to stray external magnetic fields, especially those from unsuitable mains energised turntable drive motors. One mark of a well designed cartridge is effective internal shielding to isolate it, as far as possible, from external magnetic fields from any source.

The other point has to do with the field from the cartridge's own internal magnet. It is important that the cartridge does not interact with external ferrous components, if only because it can affect the playing weight when used with a ferrous turntable.



# Fluke. First Family of DMMs.



When accuracy, performance and value are important, professionals the world over look to Fluke — the first family of DMMs.

Reliable Fluke-quality 3½- or 4½-digit DMMs fit every need — from design engineering to industrial troubleshooting.

There's the low-cost 70 Series — the most DMM you can get for the money. The tough 20 Series — totally sealed and built to survive the dirtiest, grimmest, roughest jobs. The reliable 8020B Series — made to withstand the rigors of the field service environment. The precise 8060A Series — the most powerful and complete test and measurement system available in a handheld package. And, of course, the versatile Bench/Portables that carry on the Fluke tradition for precision and durability in lab-quality bench instruments.

Fluke comes in first again with the world's largest selection of quality accessories to help extend the capabilities of your DMM even further.

There's no need to look anywhere else. Uncompromising Fluke design and leading edge technology are the reasons why attempts at imitation will never fool the millions of professionals that accept nothing less than a Fluke.

FROM THE WORLD LEADER  
IN DIGITAL MULTIMETERS.

**FLUKE**®

## **ELMEASCO** **Instruments Pty. Ltd.**

**N.S.W.** 15 McDonald St, Mortlake. Tel: (02) 736 2888  
**VIC.** 12 Maroondah Hwy, Ringwood. Tel: (03) 879 2322  
**QLD.** 243 Milton Rd, Milton. Tel: (07) 369 8688  
**S.A.** 241 Churchill Rd, Prospect. Tel: (08) 344 9000  
**W.A.** 46-48 Kings Pk Rd, West Perth. Tel: (09) 481 1500

Talk to your local distributor about Fluke

• **A.C.T.** Actec Pty Ltd (062) 80 6576 • George Brown 80 4355 • **N.S.W.** Ames Agency 699 4524 • George Brown (02) 519 5855 Newcastle 69 6399 • Bryan Catt Industries 526 2222 • Collier Tools 763 1888 • D.G.E. Systems (049) 69 1625 • Davred Electronics 267 1385 • W.F. Dixon (049) 61 5628 • Macelec (042) 29 1455 Ebson 707 2111 • Selectro Parts 708 3244 • Geoff Woods 810 6845 • **N. TERRITORY** Thew & McCann (089) 84 4999  
• **QUEENSLAND** L.E. Boughen 369 1277 • Colourview Wholesale 275 3188 • Fred Hoe & Sons 277 4311 • Nortek (077) 79 8600 • St Lucia Electronics 52 7466 • Selectro Parts (Old) 394 2422 • **S. AUSTRALIA** Protronics 212 3111 • Trio Electrix 212 6235 • Redarc Electronics 278 7488 • A.W.M. Wholesale • **TASMANIA** George Harvey (003) 31 6533, (002) 34 2233 • **VICTORIA** A.W.M. Electrical Wholesale • Radio Parts 329 7888 • G.B. Telespares 328 3371 • Browntronics 419 3986 • R.K.B. Agency 82 7704 • A.J. Ferguson 347 6688 • SIRS Sales (052) 78 1251 • Mektronics 690 4593 • **W. AUSTRALIA** Atkins Carlisle 321 0101 • Dobbie Instruments 276 8888 • Cairns Instrument Services 325 3144 • Willis Trading 470 1118



# Jaycar

## ELECTRONICS

**CELEBRATING OUR NEW  
CATALOGUE WITH A**

**15% OFF**

**EVERYTHING  
SALE  
MAY  
ONLY**

To order  
from Jaycar  
Telemail-  
Simply phone  
(008) 022 888  
Toll free and pay  
the price of a local  
call. If that's busy, use  
our Telemail Hotline  
(02) 747 1888 for orders  
and enquiries.

If you don't  
have a copy of  
our brand new 100  
page 1986 Engineers  
Catalogue, send us  
\$2.00 and we will  
send you one. It's  
crammed with lots and  
lots of new products plus  
all the old favourites.  
And ANYTHING YOU BUY  
TAKE 15% OFF the price. 15% sale  
doesn't include freight/mail costs. No  
account sales, no backorders - goods must  
be in stock and shipped in May. We cannot  
accept orders to be shipped after May.

### LS CHIPS AT SILLY PRICES.

CAT	Description	WAS	SPECIAL	Qty: 100
25 5000	74L500	80¢	40¢	30¢
25 5002	74L502	80¢	40¢	30¢
25 5008	74L508	1.10¢	55¢	42¢
25 5020	74L520	80¢	40¢	30¢
25 5074	74L574	1.25¢	62¢	50¢
25 5085	74L585	1.25¢	62¢	50¢
25 5109	74L5109	1.25¢	62¢	50¢
25 5125	74L5125	1.25¢	62¢	50¢
25 5139	74L5139	1.45¢	72¢	58¢
25 5148	74L5148	3.95¢	1.97¢	1.50¢
25 5153	74L5153	1.20¢	60¢	48¢
25 5164	74L5164	1.40¢	70¢	56¢
25 5174	74L5174	1.40¢	70¢	56¢
25 5175	74L5175	1.65¢	82¢	66¢
25 5244	74L5244	2.95¢	1.47¢	1.15¢
25 5273	74L5273	2.95¢	1.47¢	1.15¢
25 5393	74L5393	3.50¢	1.75¢	1.40¢

Prices include tax

As these are so low already do not take 15% off.

### "UNIVERSITY OF HARD KNOCKS"



#### Board game for VIC 64.

Load the cassette into your VIC 64 which  
contains 5000 questions.  
Then lay out the attractive vinyl covered  
playing board and play the game.  
Cat. X96000

**WAS \$49.95  
ONLY \$35.00  
SAVE 30%**

(Do not take another 15% off.)

# Jaycar

## ELECTRONICS

Incorporating ELECTRONIC AGENCIES

**NUMBER 1 FOR KITS**

Toll Free Hotline (008) 022 888

MAIL ORDER HOTLINE (02) 747 1888

**N.S.W.  
SHOWROOMS**

**SYDNEY:** 117 York Street Tel: (02) 267 1614  
**CARLINGFORD:** Cnr. Carlingford & Pennant Hills Road Tel: (02) 872 4444  
**CONCORD:** 115/117 Parramatta Road Tel: (02) 745 3077  
**HURSTVILLE:** 121 Forest Road Tel: (02) 570 7000  
**GORE HILL:** 188/192 Pacific Highway Cnr. Bellevue Avenue Tel: (02) 439 4799

**QUEENSLAND  
MAIL ORDERS:  
HEAD OFFICE:**

**BURANDA:** 144 Logan Road Tel: (07) 393 0777  
P.O. Box 185, CONCORD 2137  
115-117 Parramatta Road, CONCORD 2137  
Tel: (02) 747 2022 Telex: 72293

#### SHOP HOURS

Carlingford Hurstville Sydney & Brisbane  
Monday Friday 9am - 5.30pm Saturday 9am - 12pm  
Gore Hill:  
Mon-Fri 9am - 5.30pm Thurs 9am - 8.30pm Sat 9am - 12pm  
Concord:  
Monday Friday 9am - 8.30pm

#### POST & PACKING

\$5 \$9.99 \$2.00  
\$10 \$24.99 \$3.75  
\$25 \$49.99 \$4.50  
\$50 \$99.99 \$6.50  
\$100 \$198 \$8.00

ROAD FREIGHT ANYWHERE IN AUSTRALIA ONLY \$13.50



**MAIL ORDER VIA  
YOUR PHONE**



# Jaycar sale continues

Listed below are products that we have to clear out. We must emphasise that in some cases only a few of each product is available at the time of publication of this magazine ad. Many products will sell out within ONE DAY of going on sale.

If you are a personal shopper, you may actually have to travel from one store to another to get what you want. We will not backorder (as no more will become available) and will issue either credit notes or refund cheques (please specify). If you have to travel a long distance to a store we suggest that you telephone first. We emphasise, however that we cannot "hold" goods for anyone by telephone order. So act quickly, only by acting quickly you could end up with a bargain of a lifetime. Do not take an extra 15% off special prices.

## TELEMAIL PHONE NUMBERS

(008) 022 888

TOLL FREE

(02) 747 1888

HOTLINE



Cat No	Description	WAS	SPECIAL	PS-4020	2XGPO 240V Switched Outlet	\$8 95	\$4 00
AS-1000	Cer Cass FM/AM Stereo	\$199 00	\$120 00	QT 2100	Sold Iron Temperature Metr	\$29 95	\$8 00
AC-1950	Mono Rec/Play Head	\$14 95	\$7 00	QP-5517	DPM05 Case	\$5 50	\$1 50
AC-1958	Mono/Stereo Erase	\$7 95	\$4 00	QM-6100	Blow Pressure Machine	\$79 50	\$40 00
AX-3501	Radio/Stereo SW	\$4 75	\$2 25	RP-3808	5K Log/SW POT SG IMP S/L	\$2 50	\$0 50
AM-4101	SA-1 Mic Screw Adaptor	\$1 95	\$0 90	RP-3812	25K Log/SW POT SG IMP S/L	\$2 50	\$0 50
AM-4103	SA-3 Mic Screw Adaptor	\$1 95	\$0 90	RP-3902	30mm Slider Pot 5K Lin	\$1 95	\$0 50
AM-4105	SA 5 Mic Screw Adaptor	\$2 50	\$1 00	RP-3904	45mm Slider Pot 2K Lin	\$2 95	\$0 50
AV-6532	5P INDIN-5PDINREV VCAB	\$4 95	\$2 75	RQ-527	2.5 MHZ Crystal	\$6 50	\$1 00
AV-6551	Camera Cable 10M Beta14 Pin	\$89 50	\$40 00	RE-5812	220V/16V Elect Cap Axial	\$0 50	\$0 20
BS-0512	Exp IN Arif Intellig	\$17 95	\$9 00	RE-5908	640U/16V Elect Cap Axial	\$0 85	\$0 20
BS-0530	RF Circuit Design	\$34 95	\$19 50	SY-4082	Relay 24V Dip	\$1 95	\$0 40
BS-0538	How To Read Elec Ccts	\$10 95	\$5 95	TH-1981	Gripmate Extra Arms (2)	\$2 95	\$0 50
BS-0558	Digital Counter H/Book	\$15 95	\$7 50	TD-2026	S/Driver Flat Blade 150mm Med	\$0 40	\$0 10
BS-0562	Sound System Engin/RG	\$33 95	\$19 00	TD-2028	S/Driver Flat Blade 75mm H/D	\$0 60	\$0 20
BS-0566	S-100 Other Micro Bus	\$15 95	\$6 75	TD-2030	S/Driver Flat Blade 125mm H/D	\$0 75	\$0 20
BS-0572	TRS-80 Interfacing I	\$15 95	\$6 95	TD-2060	S/Driver 125x6 3mm 502	\$2 70	\$0 80
BS-0574	TRS-80 Interfacing II	\$16 95	\$7 75	TD-2062	S/Driver 150x6 3mm 503	\$2 80	\$0 80
BS-0576	PET Interfacing	\$25 95	\$11 50	TD-2064	S/Driver 150x7 9mm 504	\$4 20	\$1 20
BS-0586	The 6800 Princ Prog	\$24 95	\$11 00	TD-2070	S/Driver PHL 100x6 3mm 808	\$3 50	\$1 50
BS-0588	16-BIT Microprocessors	\$24 95	\$12 00	TD-2074	S/Driver Stub 38x6 3 500	\$2 20	\$0 80
BS-0592	80855 Cookbook	\$24 95	\$12 00	XC-4885	Multiprom Board XM2	\$29 95	\$16 50
BS-0600	Applic for your Apple	\$17 95	\$9 50	XB-9010	Book Wildcards Vol 1	\$15 00	\$5 00
BS-0602	UComp for Biz Applic	\$15 95	\$6 95	XB-9011	Wildcard Vol 2	\$16 00	\$5 00
BS-0640	Video Computers	\$11 95	\$6 50	XB-9012	Wildcards Vol 3	\$16 00	\$5 00
BS-0642	Visical Applications BK	\$25 95	\$13 50	XB-9015	Getting started on M/BEE	\$12 50	\$2 50
BS-0646	Video Fundamentals	\$22 95	\$9 75	YS-5100	Blowtron Breath Tester 05	\$75 00	\$39 00
BS-0648	Compl Home Vid Bk1	\$22 95	\$9 75	ZR-1462	62V Zener Diode 5W	\$1 20	\$0 40
BS-0649	Compl Home Vid Bk2	\$22 95	\$9 75	ZV-1542	VR78L12 -12V 100MA TO92	\$1 45	\$0 40
BS-0656	Atari Games & Recreations	\$23 95	\$12 00	ZT-2040	AC126(AC125) PNP Low Signl	\$1 20	\$0 40
BS-0658	Games Atari Play	\$23 95	\$12 00	ZT-2072	BC108 Metal Case	\$0 50	\$0 20
BS-0660	Using Commod64 at home	\$17 50	\$8 50	ZT-2104	BC204	\$0 65	\$0 08
BS-0662	Sprite Graph FR Comm64	\$28 75	\$12 00	ZT-2198	BF115 WPN SIG 30V 30MA TO72	\$1 20	\$0 20
BS-0664	Getting most fr Vic20	\$15 95	\$7 75	ZT215	BFR84	\$1 95	\$0 20
BS-0668	Sci/Eng/G Prog for IBM PC	\$19 95	\$9 50	ZT-2270	MPSA05 NPN SIG60V500MA TO92	\$0 95	\$0 10
BS-0670	Soft Soln IBM PC DBase2 etc	\$26 95	\$11 50	ZT-2271	MPSA55 PNP SIG60V500MA TO92	\$0 95	\$0 10
BS-0672	Biz Prob Solv W/IBM PC	\$35 95	\$16 50	ZL-3090	7611 (ICL7611) DCPA)	\$3 95	\$1 00
BS-0674	How to write IBM Prog	\$23 95	\$11 50	ZL-3170	UAA170 Led Driver	\$4 20	\$1 50
BS-0680	How to Microcomp Yr Sml Biz	\$15 95	\$7 75	ZL-3348	LM348	\$2 25	\$0 40
BS-0682	Robotics Primer What/How	\$17 95	\$7 50	ZL-3481	LM381AN	\$6 95	\$1 75
BS-0684	Mgr's Guide Indust Robots	\$15 95	\$7 00	ZL-3756	LM1496 Balanced Mod/Demod	\$1 98	\$0 50
BS-0694	Genesis 2 Creation 9	\$33 95	\$18 00	ZL-3805	CA3005 RF AMP Module	\$2 95	\$0 20
BS-0700	Computer cookbook	\$23 50	\$8 50	ZC-4030	4030 Quad 2IP EXCL OR GTE	\$0 80	\$0 20
BS-0704	UCSD Pascal Beginners Guide	\$19 95	\$9 50	ZC-4031	4031 64 Stage Stat Shift Reg*	\$2 20	\$0 40
BS-0760	VIC20 50 Easy Games	\$28 95	\$8 75	ZC-4032	4032 Triple Serial Adder	\$3 50	\$0 50
BA-0904	\$Computer Fr Everybody	\$9 95	\$4 00	ZC-4034	4034 85TG Tri-Stat Uni BUSRG*	\$2 95	\$0 50
BA-0908	Intro Word Processing	\$23 95	\$8 00	ZC-4035	4035 4BIT Shift Register	\$1 50	\$0 20
BS-0922	Advanced Robot Systems	\$34 95	\$13 00	ZC-4067	4067 1-OF-16 Analog Switch	\$3 50	\$0 50
BM-6500	Maplin 3800/5600 Constr Bk	\$10 00	\$2 50	ZC-4411	4411 BIT Rate Freq Counter	\$17 75	\$4 00
BM-6502	How To Play 38/5600 Synth	\$12 50	\$3 50	ZC-4500	4500 Indust Control Unit	\$7 95	\$2 00
CM-2060	M/Range Cone SM130 5/1/2	\$7 95	\$1 50	ZC-4502	4502 Strobed Hex Inverter	\$1 95	\$0 40
DC-3030	Jabber Grabber FM Ant Main	\$19 50	\$4 00	ZC-4508	4508 Dual 4-BIT Latch	\$5 00	\$0 60
DC-3105	Adpt Double Male 02-782	\$1 50	\$0 30	ZC-4514	4514 4TO16LN DCDR/4BT Lich	\$2 50	\$0 40
DC-3106	Adpt Double Female 02-783	\$1 75	\$0 30	ZC-4517	4517 Dual 64 BIT Stat Shiftr*	\$5 50	\$0 60
DC-3230	Mic Holder Mag 7-201	\$1 25	\$0 40	ZC-4553	4553 3 Digit BCD Counter	\$6 50	\$0 80
DT-5418	Marine Antenna 9 Pretuned	\$69 50	\$20 00	ZC-4557	4557 1-64BT Var-Lng Shiftr*	\$8 50	\$1 00
HL-1602	Led Holder Cliplight Yell	\$0 25	\$0 05	ZC-4580	4580 4x4 Multiport Regstr*	\$10 50	\$2 00
HM-3016	Gold Rods 500mm	\$18 00	\$2 00	ZC-4581	4581 4 BIT Alu	\$4 50	\$0 60
HM-3042	Ezi Hook Large Red	\$0 99	\$0 30	ZS-5801	7401 Quad 21/P NAND 0/Col	\$0 80	\$0 20
HM-3053	Alligator Clip Red	\$0 40	\$0 10	ZS-5805	7405 Hex Inverter Open/Cl	\$0 55	\$0 20
HE-3180	B12 Gas Sensor Figaro	\$14 95	\$5 00	ZS-5810	7410 Triple 31/P and Gate	\$0 60	\$0 20
HE-8640	16 Way 15' Edge Connector	\$4 95	\$1 50	ZS-5813	7413 Dual Anad Schmt Trig	\$0 95	\$0 20
HE-8656	85 Way 156' Edge Conn S/Lug	\$5 95	\$1 50	ZS-5814	7414 Hex Schmitt Trigger	\$0 90	\$0 20
HE-8657	85 Way 156' Edge Conn PC Type	\$5 95	\$1 50	ZS-5817	7417 Hex Buffer/Driver	\$0 95	\$0 20
KA-1118	Kit Video Enhancer	\$39 50	\$15 00	ZS-5820	7420 Dual 41/P NAND Gate	\$1 20	\$0 20
KA-1492	PH Meter LCD	\$79 00	\$35 00	ZS-5830	7430 81/P NANAD Gate	\$1 20	\$0 20
KA-1507	OPTO Option Trans. Ass. Ign.	\$19 50	\$5 00	ZS-5841	7441	\$1 90	\$0 30
KE-4003	Kit ET068 Led Dice	\$8 90	\$3 00	ZS-5847	7447 BCD 7 Seg Decod/DRVR	\$1 60	\$0 30
KE-4032	Kit House Alarm ET1582	\$44 95	\$20 00	ZS-5848	7448 BCD 7 Seg Decod/Driver	\$1 95	\$0 30
KE-4206	ETI 478 MC Mov Coil P/Amp	\$29 50	\$12 50	ZS-5853	7453 EXP 4Wide 21/P AN/OR	\$1 20	\$0 20
KE-4654	ETI733 RITY Converter 04/83	\$24 95	\$11 50	ZS-5870	7470	\$1 15	\$0 20
KE-4671	Parallel Interface Kit M/BE	\$15 95	\$7 00	ZS-5874	7474 Dual D Flip Flop	\$1 15	\$0 20
KE-4672	ETI672 TTY Interface 10/83	\$15 95	\$6 00	ZS-5876	7476 Dual JK M/S Flip Flop	\$0 80	\$0 20
KE-4683	Masterplay amplifier	\$69 95	\$35 00	ZS-5883	7483	\$1 45	\$0 30
KE-4693	OP-Amp Tester ETI 183	\$29 95	\$14 50	ZS-5885	7485 4 BIT Comparator	\$1 60	\$0 30
KE-4695	Modem Kit ETI 699	\$139 00	\$69 50	ZS-5886	7486 Quad Exclusive or GT	\$0 90	\$0 20
KE-4703	Electronic Jumper Leads	\$39 95	\$20 00	ZS-5890	7490 Decade counter	\$1 20	\$0 20
KS-1887	HE117 House & Car Alarm	\$19 95	\$8 50	ZS-5891	7491 8 BIT Sift Register	\$1 60	\$0 30
KS-8123	HE123 Alien Invaders	\$15 50	\$7 00	ZS-5892	7492 Divide by 12 Counter	\$1 20	\$0 20
KS-8128	HE128 Foghorn	\$8 50	\$3 50	ZS-5898	74198 8 BIT R/L Shift Regis	\$3 90	\$0 50
LT-3255	STD Off Nail in Ribn	\$0 20	\$0 04	ZS-5906	74191 Sync UP/Down BIN CT	\$1 75	\$0 30
LA-5030	Composite Contr Alarm Modul	\$47 90	\$22 50	ZS-5907	74192 Up/Down Decade Cntr	\$1 75	\$0 30
LA-5105	Strobe Flasher 12V	\$32 50	\$16 50	ZS-5908	74193 Up/Down Binary Cntr	\$1 95	\$0 30
LA-5180	Alarm Micro 4 control	\$209 00	\$50 00	ZZ-8072	CD1822	\$11 50	\$1 50
LA-5305	Car Alarm MDL AAB12	\$45 00	\$20 00	ZZ-8102	DM2502	\$11 95	\$1 50
PS-2202	VS-8 SV Video Conn. Skt 8 Pin	\$7 95	\$2 75	ZK-8880	TA7205P Audio Amp	\$4 50	\$1 00



# Replace those ageing Twin 25s with the **Playmaster Sixty-Sixty stereo amplifier** **Pt.1**

*Behold the Playmaster Sixty-Sixty! This is the amplifier you have been waiting for to replace all those ageing Playmaster Twin Twenty-Fives, the Forty-Forties and the Mosfet stereo amplifier. The new amplifier offers a standard of performance far ahead of anything we have previously published and ahead of most commercial integrated stereo amplifiers.*

**by JOHN CLARKE**

We have really excelled ourselves this time. This new amplifier is so good it is almost embarrassing.

Recently, quite a few readers have asked us to update the very successful Playmaster Twin Twenty-Five and Forty-Forty amplifiers. These were probably the most popular and reliable stereo amplifiers we ever published and they were very easy to build. Sure, readers were impressed with the recent Playmaster Series 200, 100 watt/channel amplifier but it was a no-holds-barred design possibly too ambitious for many tastes; and too big for many wallets.

So we set out to design a replacement for the above-mentioned amps, using a lot of the experience gained in designing the Series 200. First, it had to be easier to build — much easier than the Series 200 but still without any shielded cable

wiring, indeed with as little wiring as possible. That meant a single board design with everything on it, including RCA input sockets and all the power supply, except for the power transformer.

At the same time, we did not want to incorporate CMOS signal switching, as we did in the Series 200. The need for all those buffer stages, to keep distortion as low as possible, plus the additional logic circuitry, means that the design becomes rather complicated.

This new amplifier had to be simple, use no shielded cable for the input wiring and yet we wanted the basic specs to be at least comparable with the Series 200. Could it be done?

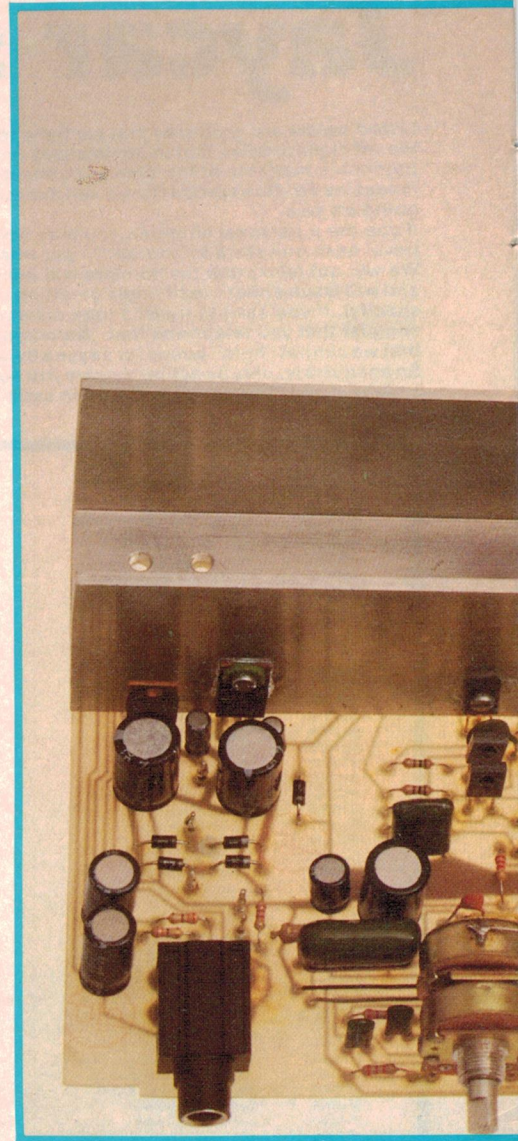
We started out by deciding that we would not use power Mosfets. While they do have their advantages, they

have a big drawback in that they require a high quiescent (no-signal) current. That means that they have to dissipate quite a lot of power at all times. They get hot.

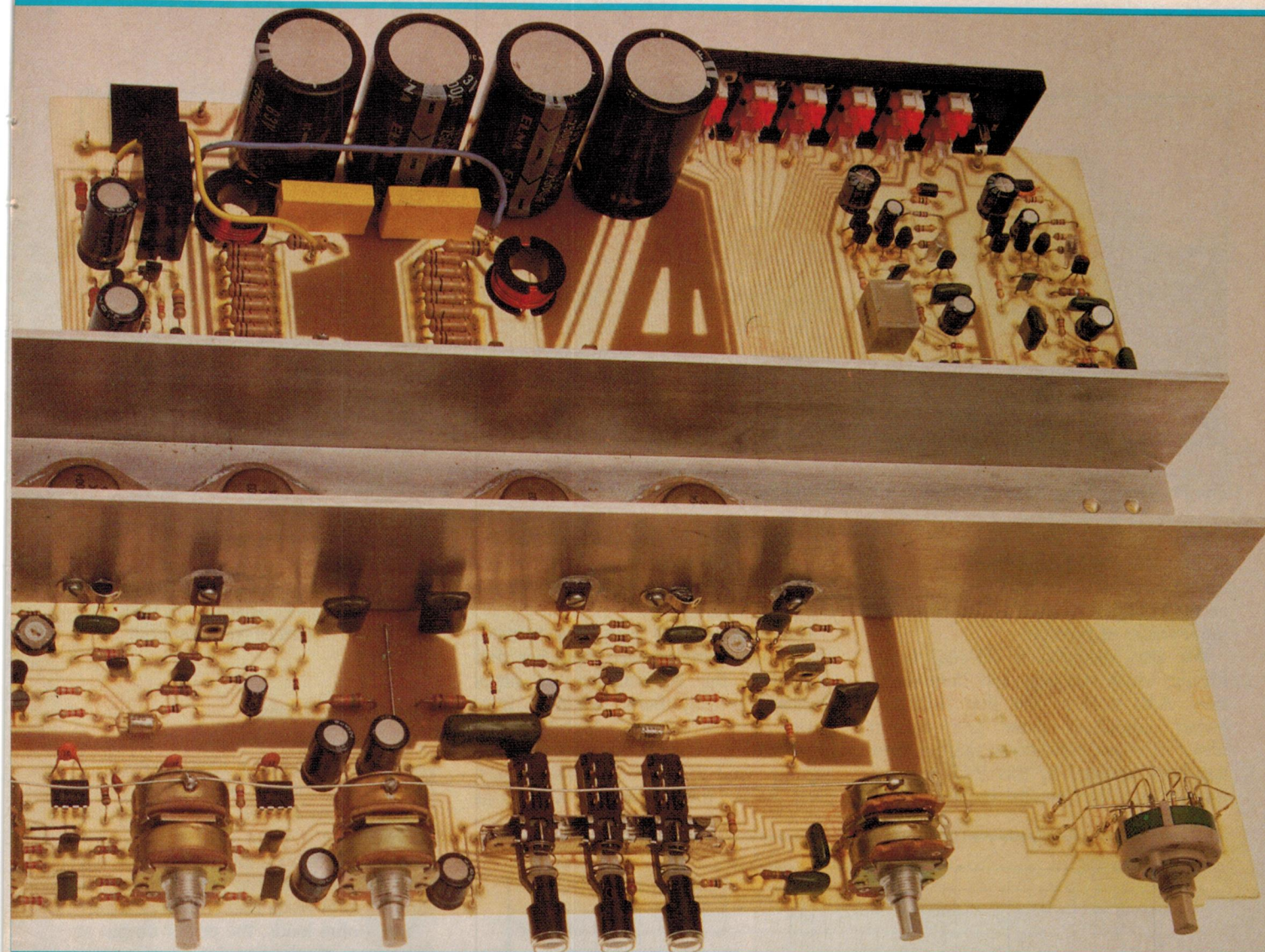
Mosfets also have higher dynamic losses than bipolar transistors and so require bigger heatsinks. We wanted to use a U-shaped channel heatsink which would run across the width of the amplifier and be mounted directly on the printed circuit board. With Mosfets that would be unworkable. So we selected the most rugged bipolar transistors available at a reasonable price: MJ15003 and MJ15004.

These enabled us to design a very rugged output stage which is able to deliver very high currents and quite surprising amounts of power.

As far as the shielded cable wiring was concerned, we took the simple way out. Don't have any cables at all. Just







run the conductors from the high level inputs across the printed circuit board to the control circuitry at the front. And in between the signal conductors run earth conductors to keep crosstalk to a low value.

We pinched the basic layout concept from the Luxman L-215 amplifier. After all, why re-invent the wheel? The concept is elegant and eliminates the need for shielded cable, which is very tedious to wire into place.

The concept of no shielded cable works because all hifi program sources such as CD players, tuners and cassette decks have high level signals of around 500mV to 2 volts and they have low impedance outputs. That means that electrostatic signal pickup by the unshielded signal lines on the board tends to be swamped out by the low impedances and high signal levels.

Of course, it wasn't quite as simple as

that in practice. We discovered that earthing arrangements for the individual signal paths were very critical when it came to consistently achieving the very low distortion figures that we eventually obtained. We had to ensure that we obtained essentially the same distortion results no matter which set of inputs was selected and whether or not the tone

controls were in or out of circuit. That proved to be quite tricky to achieve.

We also discovered that we could not use wirewound emitter resistors in the power amplifier stages because they radiated substantial energy into the nearby input tracks. This caused high distortion at the higher frequencies and at high output powers.

## Features of the new amplifier

- ☆ 60 watts per channel with both channels driven into 8-ohm loads
- ☆ Very low noise on phono and line level inputs — better than CD performance.
- ☆ Very low harmonic and intermodulation distortion
- ☆ Excellent headroom
- ☆ Tape monitor loop
- ☆ Tone controls with centre detent and defeat switch
- ☆ Mono/stereo switch
- ☆ Toroidal power transformer
- ☆ Easy-to-build construction
- ☆ Very little wiring



# Playmaster amplifier



The Playmaster Sixty-Sixy is built into a rack-mounting case and matches the styling of our new Playmaster Stereo AM/FM Tuner.

That problem was solved by using several paralleled carbon resistors for the emitter resistors and keeping them at right angles to and as far from the input tracks as possible.

We also specified a toroidal transformer which has very low hum radiation. And it turns out that since the power amplifiers draw less current under no signal conditions, there is even less hum radiated by this 160VA transformer than the toroidal transformer in

the Playmaster Series 200. The net result is an even better noise performance than the Playmaster Series 200. That's the embarrassing part.

The final product is a very refined, simple high performance amplifier that challenges the performance of many commercial amplifiers, whether integrated models or even higher priced preamplifier and power amplifier combinations. And the price? That's the best part. At the time of writing it looks as

though it will go on sale for quite a bit less than \$250.00.

In real dollar terms it is much better value than the \$89 price of the Playmaster Twin Twenty-Five amplifier ten years ago.

## Specifications

To put it into a nutshell, we have given this amplifier a continuous rated power of 60 watts per channel, with both channels driven. But it is capable of delivering a great deal more power than that. For example, when just one channel is driven, the power output at clipping is 74 watts into an 8-ohm load.

Into 4-ohm loads, the power output at the onset of clipping is 72 watts per channel with both channels driven and 88 watts with one channel driven. For short term power capability (music power), as measured by the Institute of High Fidelity specification IHF-A-202, the new amplifier can deliver 105 watts into an 8-ohm load for a single channel, and no less than 153 watts into a 4-ohm load under the same conditions. For an amplifier with a nominal rating of 60 watts per channel, that is an excellent performance.

(This IHF test for music power involves using a 1kHz +20dB toneburst superimposed on a constant 1kHz signal. The tone burst is 20 milliseconds long at a rate of two bursts per second.)

Rated harmonic distortion of the amplifier is less than .01% for all powers up to 60 watts per channel into 8-ohm loads, over the frequency range from 20Hz to 20kHz. For 4-ohm loads, the rated distortion is less than .015% for all powers up to 70 watts per channel,

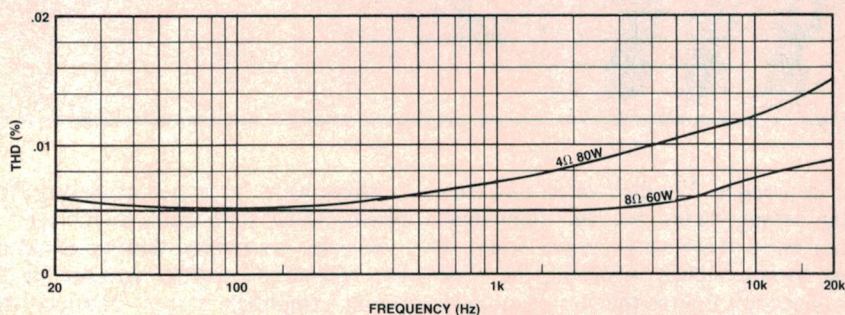


Fig. 1: graph showing total harmonic distortion (THD) versus frequency (see text).

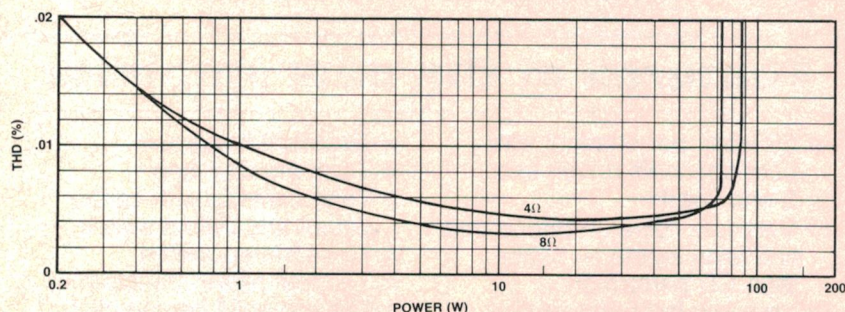


Fig. 2: THD versus power output for 4Ω and 8Ω loads at 1kHz. The apparent increase in THD below 10W is due to the increasing effects of residual noise.



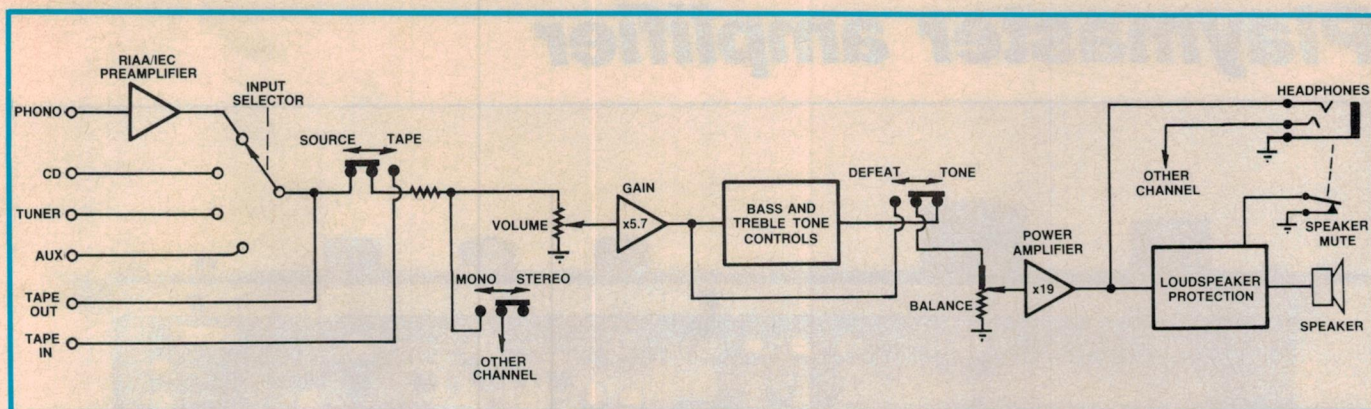


Fig.3: this block diagram shows the relevant features of the new Playmaster Sixty-Sixy stereo amplifier.

for the same frequency range.

At normal listening levels though, the distortion will typically be much lower, at around .005%. We have plotted graphs of total harmonic distortion (THD) versus power into 4-ohms and

8-ohm loads at 1kHz to give some idea of this trend. Note that the THD is shown as rising for powers below 10W but this is due to the increasing effect of residual noise rather than an actual increase in harmonic distortion.

## Hum & Noise

Hum and noise figures for the amplifier are among the best we have seen in any amplifier. For all the line level inputs, the new Playmaster is actually better than any currently available compact disc player, with a signal-to-noise ratio of better than 103dB with respect to maximum sensitivity and full power.

Such a high figure really doesn't mean much to the average listener. In practical terms, it means that with a CD player plugged in, turned on, but with no music playing, and with the amplifier volume control turned right up, no sound will be heard from the loudspeakers. And that applies even if you place your ears right up against the speaker cones! It is really that quiet.

And for the moving magnet phono inputs, the signal-to-noise ratio is no less state-of-the-art at 89dB with respect to 10mV at 1kHz. These noise figures are unweighted by the way, which means that they are even better than the weighted figures used by some manufacturers.

## Amplifier facilities

We have kept the operating features of the new Playmaster as simple as possible, to keep costs to a minimum and to simplify the design. That means that we have omitted switching for two pairs of speakers and comprehensive dubbing facilities for two cassette decks. We have also not included a muting switch which is a nice but seldom-used feature and moving coil cartridges are not catered for.

So the facilities are basic without being spartan. There are four sets of inputs, one for a moving magnet cartridge, and three line level sources: compact disc player, tuner and Aux (hifi VCR, musical instrument or whatever). There is also a tape monitor loop for connection of a cassette deck or

## PERFORMANCE OF PROTOTYPE

POWER OUTPUT	One channel	Both channels
4 ohms	88W	72W
8 ohms	74W	62W
Dynamic power (IHF-A-202)		
4 ohms	153W	120W
8 ohms	105W	95W

(all measured with 240VAC regulated supply)

### HARMONIC DISTORTION

less than .01% for all powers up to 60W into 8Ω loads  
less than .015% for all powers up to 70W into 4Ω loads  
(see graphs)

### INTERMODULATION DISTORTION

less than .01% for all powers up to 60W into 8Ω loads  
less than .012% for all powers up to 80W into 4Ω loads

### FREQUENCY RESPONSE

Phono inputs RIAA/IEC equalisation within  $\pm 0.5$ dB from 40Hz to 20kHz  
Line level inputs  $-0.5$ dB at 20Hz and  $-1$ dB at 20kHz

### CHANNEL SEPARATION

(measured at 60W)

10kHz	66dB
1kHz	75dB
100Hz	79dB

(undriven inputs loaded with 1kΩ)

### INPUT SENSITIVITY

Phono inputs at 1kHz 4.3mV  
Overload capacity at 1kHz 140mV  
Line level inputs 270mV

### HUM & NOISE

Phono (with respect to 10mV at 1kHz) 89dB unweighted, with typical moving magnet cartridge  
High level inputs (with respect to 270mV) 103dB unweighted with 20Hz to 20kHz bandwidth

### TONE CONTROL

Bass  $\pm 12$ dB at 50Hz  
Treble  $\pm 12$ dB at 10kHz

### DAMPING FACTOR

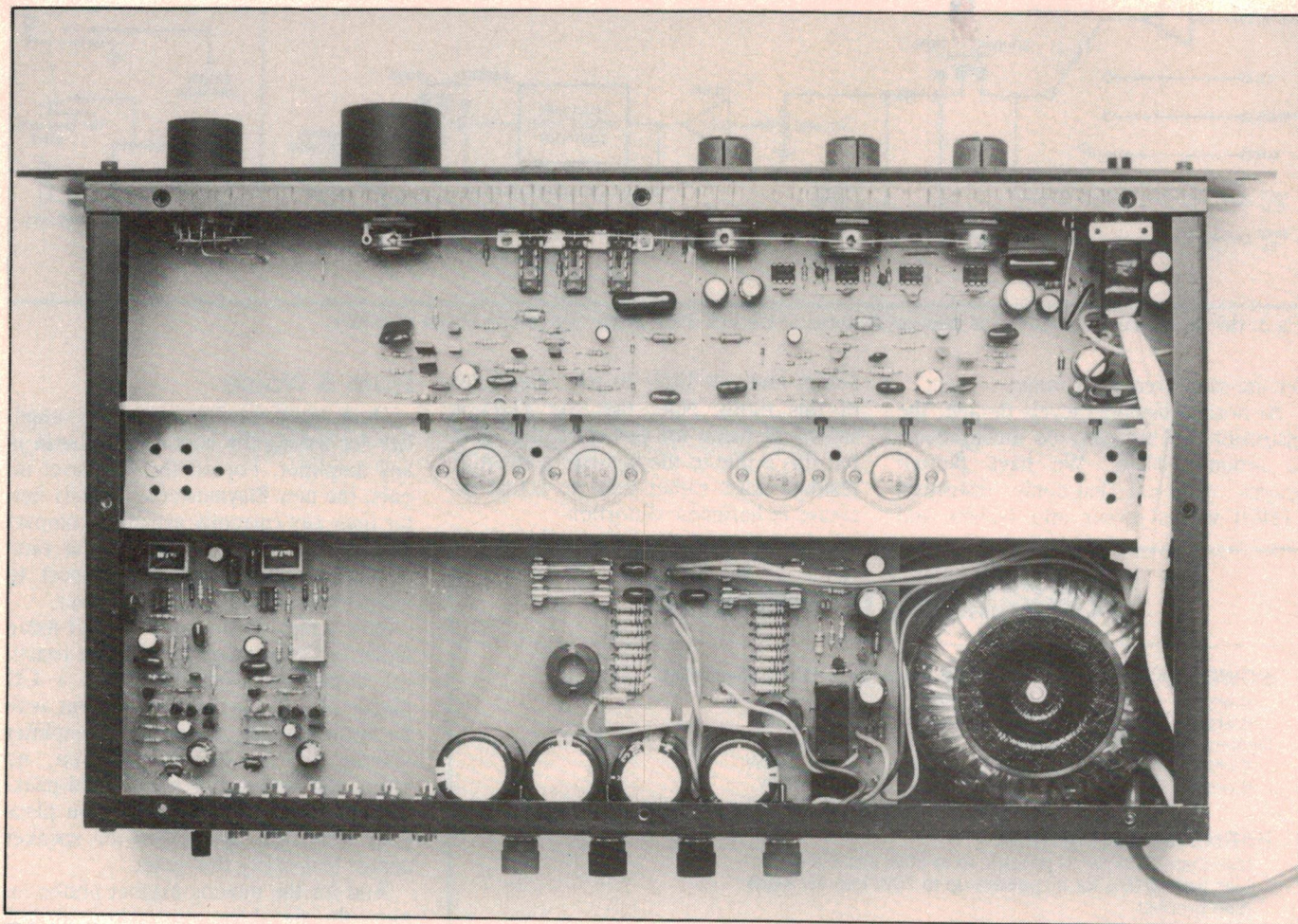
at 1kHz  $> 80$   
at 30Hz  $> 80$

### STABILITY

unconditional



# Playmaster amplifier



This interior view emphasises just how easy construction really is. Note the U-shaped heatsink running across the PC board.

graphic equaliser.

Unlike some commercial amplifiers, notably from England, we have included Bass and Treble controls. But if you don't like tone controls you can switch them completely out of the circuit with the Defeat switch. Not that it makes any difference to the measured distortion figures but there you are. You can have tone controls or you cannot. The choice is yours. You pay for them anyway.

So if you have a look at the front panel of the amplifier you will see that it has the normal knobs for Volume, Balance, Bass, Treble and Input Selector. There are four pushbutton switches, for Power, Mono/stereo, Tone defeat and Tape monitor.

There is also a stereo headphone socket which disconnects the speakers when the phones are plugged in.

Only one set of loudspeakers is catered for. The terminals for these are heavy-duty binding post-cum-banana terminals.

## Overload insurance with CD players

Since the amplifier is so quiet, there is a risk that people will turn up the wick unreasonably before playing a compact disc. That brings with it the risk of blowing your loudspeakers as soon as the disc begins to play. To avoid that, we have marked the setting on the volume which corresponds to full power at the maximum CD 2V signal level.

The mark is an approximate guide only but if you turn the volume control beyond this setting you run the risk of over-driving the amplifier and perhaps blowing your speakers. So, it's included as an insurance feature. Ignore it at your own risk.

Another feature of the potentiometer controls is their smoothness and inclusion of detents. The volume control has 41 detents which makes it easy to repeat a wanted setting. Similarly, the tone controls and balance control have a cen-

tre detent to make it easy to find the normal "flat" or centre setting.

The pots are specially sourced from Japan and we strongly recommend that all suppliers use pots of equivalent quality. They really do make an important difference to the feel of the amplifier.

Overall size of the amplifier is 483 x 88 x 254mm which is the same as a standard two-unit high rack-mounting chassis.

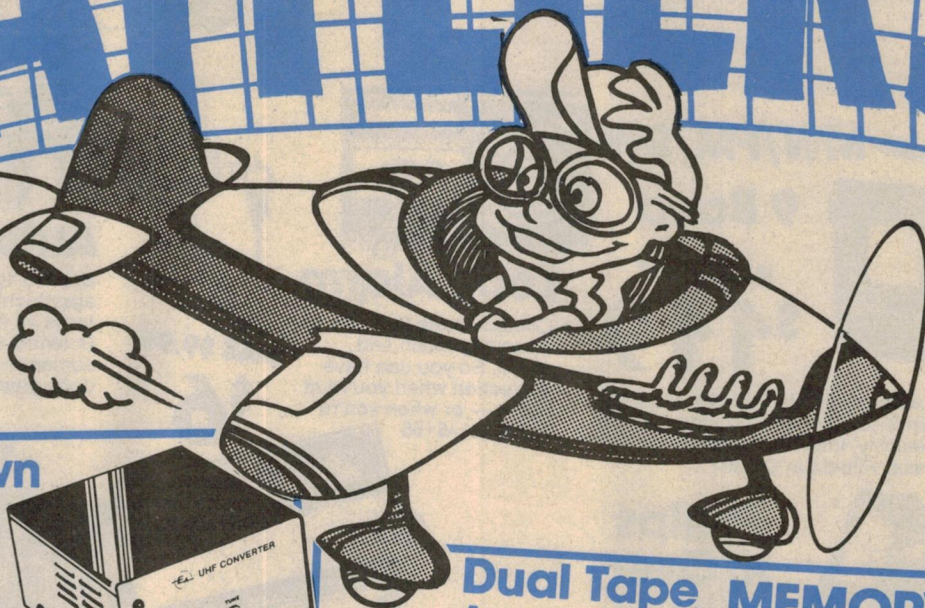
## Circuitry

In essence, the circuitry is the core of the Playmaster Series 200 but without the CMOS switching, logic circuitry and 20Hz rumble filtering. The power amplifier is also very similar to the Playmaster Series 200 but uses complementary bipolar power transistors in a Darlington configuration rather than MOS-FET devices.

Next month, we shall publish and describe the complete circuit of the new amplifier.



# MAYELLERS



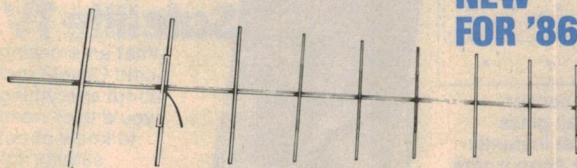
## VHF/UHF Down Converter Kit

**\$69<sup>50</sup>** NEW FOR '86



Now view UHF transmissions without the expense of buying a new TV set. It's essential for the new Ch-28 and poor VHF reception areas serviced by UHF. Measuring a mere 93x40x25mm, this easy to assemble module plugs into antenna socket. Using a lower end VHF channel, it covers UHF bands 4 and 5 (526-820MHz). All you need is a UHF antenna and presto... a whole new world of TV enjoyment!  
Cat K-3236

**VHF 2m 'Yagi' Antenna Kit** **\$89<sup>95</sup>** NEW FOR '86



Excellent value for the 2m amateur. Brilliant 12dBd gain provides that all-important extra range. Pre-drilled to eliminate tuning hassles... so you can install it in no time!  
Cat K-6297

## Turns Any Old TV Into A CRO!

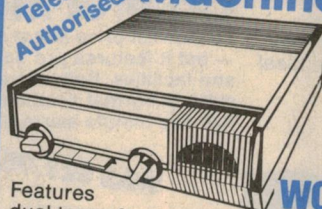
**\$34<sup>50</sup>**



Real money saver for all hobbyists! This sensational CRO adaptor kit converts that old black and white (or colour) TV set into a fully functional 300kHz oscilloscope. Provides excellent display at low frequencies. Only requires a 100mV for full screen deflection. Kit comes with complete components and instructions.  
Cat K-3060

## Dual Tape Answering Machine

Telecom Authorised



Features dual tapes for convenience, remote beeper for message retrieval from any other phone (anywhere in the world!) and much, much more. Great machine? You bet!  
Cat F-6136

**WOW!**

**\$269**

## MEMORY PHONE WITH MUSIC!

Sensational value for a 12-number memory phone with a host of features. Last number redial and mute buttons PLUS 'music' function which entertains callers waiting on line  
Cat Y-1184

Telecom Authorised

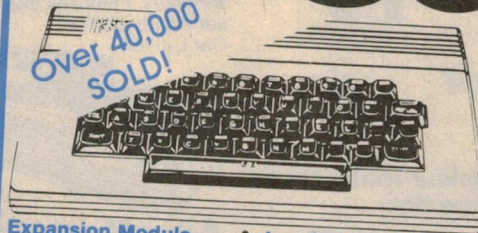


**\$49<sup>95</sup>**

## VZ-300

**VALUE!**

Over 40,000 SOLD!



Our popular VZ-300 colour computer offers 16K RAM colour and sound. The whole family can use it for budgeting, education and games.  
Cat X-7300

**\$99**

### Expansion Module

Just so it doesn't forget! Take your VZ-300 memory from 18K to 32K units. You'd hardly need any more.

16K module  
Cat X-7306

**\$84<sup>50</sup>**

### Joysticks and Interface

Add new dimensions to your games with these super responsive joysticks. Comfortable lightweight and easy to operate. Cat X-7315

**\$49<sup>50</sup>**

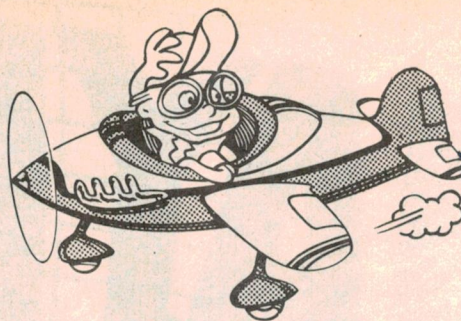
### Data Cassette

Store your programs and data for later retrieval! This deluxe recorder is made just for the VZ-300. Plugs straight in. Cat X-7310

**\$69<sup>50</sup>**



STOCK AVAILABILITY...  
TO AVOID DISAPPOINTMENT  
PLEASE PHONE YOUR  
NEAREST DSE STORE.



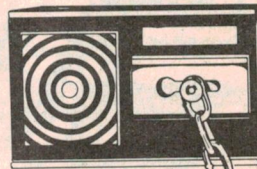
**MW/FM/SW**

**9 Band**

WAS \$139

**\$119**

Tune in to the world brilliantly with this incredible dual conversion 9-band receiver. Offers superb sensitivity, selectivity, interference rejection and stability. Colossal value! Cat D-2837



**Lock Alarm**

Combines the features of a security chain and alarm. So you can have protection when you're at home — or when you're out. Cat L-5155



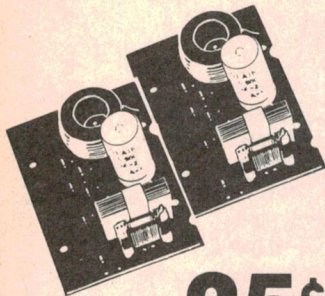
**Auto Night Light**

Superb light system sense people approaching and automatically turns on its two bright spot lights. Potential intruders will think there's someone at home. Ideal as a front door greeting light too! Cat L-5170

WAS \$9.95

**\$6**

WAS \$149 **\$99**



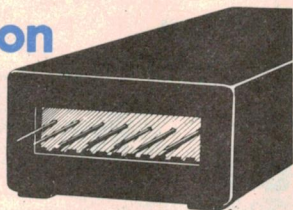
**Philips  
X/Over  
2 Way  
Speakers**

Use in your own design for a two-way speaker system. Ideal cross-over characteristics. Cat J-1022

WAS \$1.00 **25¢**

**Negative Ion  
Generator**

You've heard all about Negative Ion Generators and their benefits, buy the kit and find out what it's all about. Many commercial units run from the mains, but our kit is safe — it runs on 12V DC, which also means that you can put one in your car. Cat K-3335

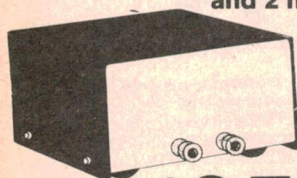


WAS \$24.50

**\$19.50**

**13.8V Power  
Supply**

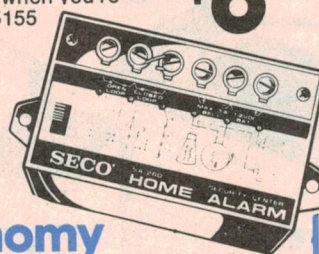
Ideal for smaller amateur transceivers and 2 metre rigs



WAS \$42.50

**\$35**

A big 5 amps continuous rating and 6 amp peak (depending on the heatsinks used) from this supply. Comes with all components, PCB, etc, but no 'hardware'. Build it Cat K-3449



**Economy  
Control Module**

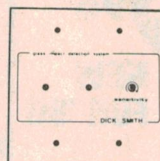
The lowest price alarm module around — but it features pro quality circuitry and facilities. Both n/o and n/c inputs, suits all normal detection devices and has one minute alarm period. Cat L-5060

WAS \$29.95

**\$25**

**Glass  
sensor  
alarm**

Compact, simple to install sensor guards both large and small glass areas... a deliberate impact instantly triggers an alarm. Ideal for shop fronts or home glass sliding doors and windows. Features adjustable sensitivity control. Cat L-5165



WAS \$29.95

**\$20**



**Appliance Alarm**

Protect your VCR, your stereo, your TV... anything! Just plug them into this alarm: and if some light-fingered Louie tries to lift your loot, look out! The alarm soon suggests he change his mind! Cat L-5052

WAS \$69 **\$50**

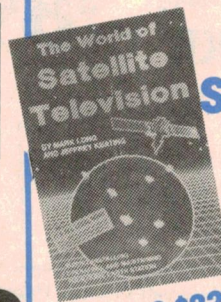


**Home  
Satellite  
TV**

Home Satellite Television by Rick Cook & Frank Vaughan 326 pages. If you're thinking about your own station or just curious this one has the answers. Cat B-1840

WAS \$15

**\$10**



**The  
World Of  
Satellite TV**

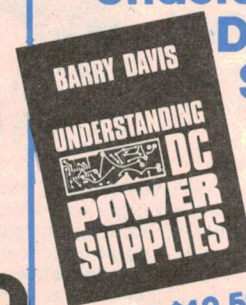
What an amazing book! Covers just about everything you'd ever need to know about satellite TV. Cat B-1842

WAS \$22.95

**\$10**

**Understanding  
DC Power  
Supplies**

Covers everything from introduction to rectifiers to switch mode supplies. Cat B-3623



WAS \$19.50

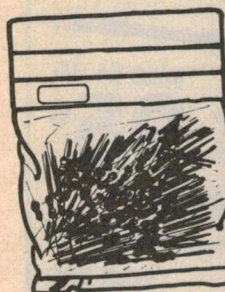
**\$12**



# DISCONTINUED

## BARGAINS!!!

### 1000 Pieces Mixed Components

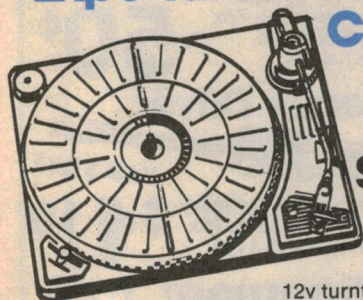


No we haven't made a mistake, and yes we might be crazy but we must clear this stock — 1/4W/.5W/1W/resistors, electro caps/trimpots/green caps/ceramics and more. All assorted values in one bag. That's less than \$0.01¢ each — Be quick limited stock — never to be repeated.

Cat R-9000

**\$9<sup>95</sup>**

### Expo Turntable With Cartridge



12v turntable with ceramic cartridge — it's a wipe out bargain price. Cat J-1060

WAS \$19.50

**\$14<sup>95</sup>**



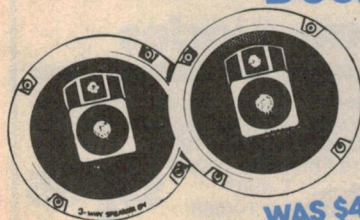
### Speakers 7x5 W/Grill

4 ohm replacement speakers, oval shape. Cat J-1025

WAS \$6.95

**\$4<sup>75</sup> Pr**

### Car Speaker DSE Door Mount



40w. max. 3 way door mount speaker system. Cat A-7055

WAS \$49

**\$39 Pr**

### Water Resistant Carry Bag



Cat A-4010

WAS \$9.95

Anyone who owns a Walkman or other Walkie-type stereo or AM/FM radio knows the hassles: get them wet and they tend to stop. Bad news if you like sailing, Fishing. Or just mucking around near water. Solve the problem with this water resistant carry bag.

**\$6<sup>95</sup>**

### Personal AM/FM Stereo

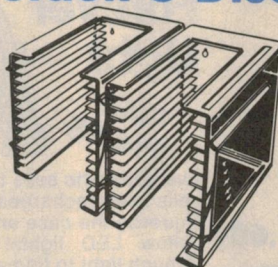


Fantastic sound! This AM/FM stereo radio comes complete with famous quality Mylar headphones. Compact and lightweight it's easy to move around with you. Cat A-4001

WAS \$29.95

**\$24<sup>95</sup>**

### Stack-O-Disc



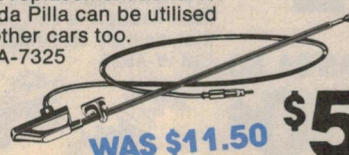
Holds 24 compact discs, ideal storage unit to protect your discs. Cat C-3900

WAS \$19.95

**\$16<sup>50</sup>**

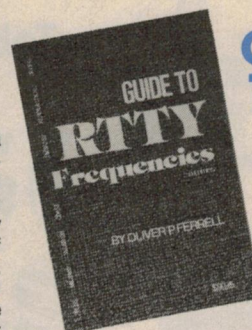
### Car Aerial

Ideal replacement aerial for Mazda Pilla can be utilised for other cars too. Cat A-7325



WAS \$11.50

**\$5**



### Guide To RTTY

Contains a comprehensive listing of commercial, aeronautical, maritime, press, embassy, UN and military RTTY activity.

Cat B-2070

WAS \$9.95

**\$7**

### Beam Antenna Handbook

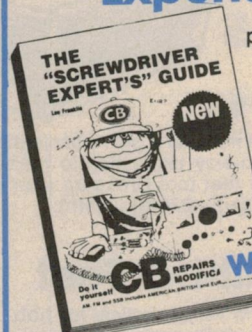


Correct beam dimensions 6 to 40 metres. Are 40 metre beams worth the effort? Cat B-2306

WAS \$14.50

**\$10**

### Screwdriver Experts Guide



Franklin — 97 pages. The do-it-yourself CB repairs and modifications manual for the CB freak with NO electronics knowledge! Cat B-2324

WAS \$14.50

**\$10**

### Cassette Carry Pouch



**\$8<sup>75</sup>**

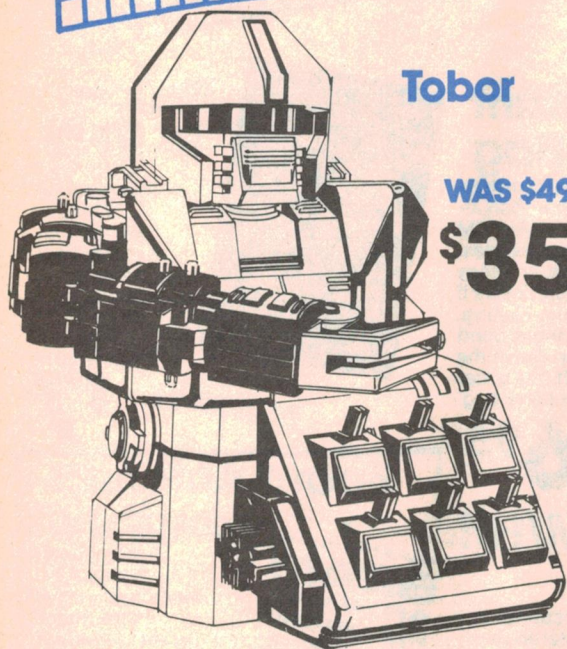
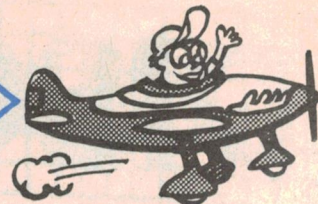
WAS \$19.95

Wow! Now take a swag of your favourite tapes anywhere with this superb carry pouch! Holds up to 12 tapes. Pouch rolls up into a convenient 'pack anywhere' shape. Features adhesive tape for car dash mounting. Cat C-3820



NOT ALL STOCK AVAILABLE AT ALL STORES — TO AVOID DISAPPOINTMENT PLEASE PHONE YOUR NEAREST DSE STORE.

# SELLOUT!



**Tobor**

WAS \$49

**\$35**

Amazing robot with a fully working arm and claw. Six separate control levers for raising his arm, open and close his claw. He can lift objects (up to 100g). A great introduction into robotics.  
Cat Y-2065

## Instrument Case

**\$19.95**

WAS \$34.95



What a case! It will make any grotty project look a million dollars! With multi-way tilting bail to hold case at an angle, has rubber feet too! Dress up your project. Buy coloured, size 210(w) x 270(d) x 73(h).  
Cat H-2525

## 'Giant' Rubber Feet

Excellent value! And very practical for hobbyists' needs. Place under project cabinets to prevent slipping, scratching table surface. Also provides ventilation for power projects.  
Pk/4. Cat H-1738

WAS .60¢

**20¢**

## The Big Guns

The incredible Molon reluctance synchronous 230 volt motors. Heavy duty cast-iron outer casing, they're quality manufactured in USA. Cat J-1016

WAS \$5.95

**\$2.50**

## Power Plant!

Wow! Quality Matsushita brand (ie National Panasonic) 13.2 volt DC motors. With 2.5mm shaft, they're 45mm in diameter and ideal for those larger projects. Cat J-1018

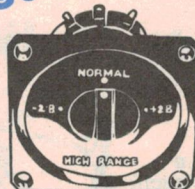
WAS \$1.50

**50¢**

## High Range Level Controls

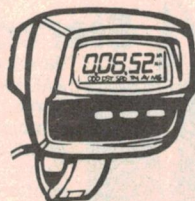
**\$3**

WAS \$3.95



Whether you have ready built speakers, or you're making your own speakers, this fader will give you the control you need over the sound from your system. Dual concentric, heavy duty wire wound elements ensure proper loading of the crossover and amplifier at all times.  
Cat C-7212

•High Power handling capacity •Attractive & easy to mount •Latest flush design •Fully sealed front and back-no air leaks! •2dB calibration markings •Available with either high or midrange labels.



## Bicycle Computer

WAS \$39.50

**\$30**

This incredible high precision bicycle computer is a useful and fun accessory for the pleasure rider, serious competitor or exercise enthusiast. Suits any bike with standard spokes.  
Cat Y-3010

## Forever Light

WAS \$14.95



Everyone who sees this is amazed! Solar cells keep rechargeable cells topped up. Squeeze the case and a high brightness yellow LED lights! Gives more than enough light to find a keyhole, etc. And it comes complete with keychain.  
Cat Y-1075

**\$11.50**

## Test Lead Set

Ideal for the hobbyist! This deluxe test lead set will have all you should need for the workshop or toolbox. Screw in any of the 14 adaptors and plugs and you will see that it's truly versatile.  
Cat W-4526

WAS \$8.45

**\$6**



## TOOLS HALF PRICE

### Phillips



WAS \$1.95

**95¢**

Phillips head screw driver: 125x5x85x18mm. Cat T-4050

### Baby Drivers



WAS 85¢

**40¢**

For light electrical work: 50x49x11mm. Cat T-4080

Ideal for general purpose work: 75x4.5x73x16mm. Cat T-4085

WAS \$1.00

**50¢**

### Heavy Driver



WAS \$2.25

**\$1.10**

Tough driver for heavy-duty jobs: 125x6x90x25mm. Cat T-4100

### Alignment Tool Screwdriver Type



WAS \$1.75

**\$1.85**

Plastic screwdriver with steel spring tip: 100mm. Cat T-4510

### Piercing (Fret) Saw



WAS \$14.25

**\$7.10**

An absolute MUST for the modelmaker, hobbyist, etc. Fully adjustable universal type saw frame, complete with 3 blades.  
Cat T-4965

### Saw Blades



When you need replacements there is a choice of three special SKS alloy blades in packs of 12:

Extra Fine: Cat T-4966

Fine: Cat T-4967

Medium: Cat T-4968

WAS \$2.75

**\$1.35**



## Stingray HF Marine Transceiver

**SPECIAL PRICE PACKAGE DEAL**  
— fitted with 2182kHz complete with 2182 whip and base!

**\$2495**

Quality performance and ease, it's all here with the Stingray! This powerful 100W SSB marine transceiver will handle any of the marine channels with ease. Suitable for all HF marine frequencies including emergency club, chatter frequencies, etc. Why settle for second best? Very heavy construction makes it a rugged workhorse — so you can count on it in a crunch! Plug-in frequency cards give you single knob selection over the 2-30MHz range so selection is child's play. Comes complete with mounting hardware and mic — just take away and fit in a day!

Just look at these value for money features:

- 100W SSB
- Suitable for any marine channels
- 2.30MHz range
- Plug-in frequency cards for single knob selection and much more! Cat D-1410

**NEW FOR '86**

THESE PRODUCTS AVAILABLE ON ORDER IF NOT IN STOCK IN ANY STORE.

## Antenna Tuning Unit

**NEW FOR '86**

**\$699**

— Suitable for use with longwire or backyard antennae etc. for maximum range

Say goodbye to all those antenna matching hassles, once and for all! The Stingray Antenna Matching Unit can match your transceiver to any antenna without fuss or bother. Why waste time adjusting equipment when you can be out there having a good time? You'll get maximum performance from your transceiver with minimum risk of damage from high SWR. Operates over the 2-30MHz range. Get the most from your transceiver — your safety depends on it! Cat D-1412

## Stingray Noise Blanker/Mute Card

Accessory for Stingray HF Marine radio. Effectively reducing annoying background noises. Easily plugs into transceiver. Cat D-1414

**\$199**

**NORMALLY \$2499 just for the transceiver**

## T.V. Antenna Bargains!

### Stingray Loaded Whip Antenna

2182KHz loaded whip that puts a 'sting' into marine communications. Operates on the international marine distress frequency. Cat D-1418

**IDEAL BACKUP ANTENNA**

**\$199**

### UHF/VHF Antenna

Here's one antenna to suit both UHF & VHF. High gain with corner reflector for top UHF performance is ideal for fringe areas. Cat L-4018 7.5dB gain

**\$89<sup>95</sup>**

### Combined UHF/VHF

Why put up two antennas when one antenna will give you both UHF and VHF signals? One of our most popular antennas. Cat L-4020 6dB gain

**\$69<sup>95</sup>**

### Ghost Buster Antenna

Live to close a signal source? Picture quality reduced by excessive ghosting! Here's the answer: DSE's amazing Ghost Buster! Cat L-4023

**\$99**

### Indoor Antenna

If you're lucky enough to live in a strong signal area, you'll probably get by with one of these spiral antennas, even with colour. Cat L-4010 300 ohms impedance

**\$9<sup>95</sup>**

### Rabbit Ears...

When an outdoor antenna isn't possible or connecting a second TV set is too much trouble, count on the good old rabbit ears... the indoor antenna that sits on your TV set. Cat L-4015

**\$16<sup>95</sup>**

## BITS 'N' PIECES BARGAINS FOR YOU!

### 7400 Quad 2 input NAND gate

Cat Z-5010 Was 50¢

**Now 30¢**

### 7401 Quad 2 input NAND o/collector

Cat Z-5011 Was 50¢

**Now 30¢**

### 7402 Quad 2 input NOR gate

Cat Z-5012 Was 60¢

**Now 40¢**

### 7404 Hex inverter

Cat Z-5014 Was 75¢

**Now 50¢**

### 7405 Hex inverter open collectors

Cat Z-5015 Was 60¢

**Now 40¢**

### 7408 Quad 2 input AND gate

Cat Z-5018 Was 60¢

**Now 40¢**

### 7410 Triple 3 input NAND gate

Cat Z-5020 Was 60¢

**Now 40¢**

### 7414 Hex Schmitt trigger

Cat Z-5024 Was 85¢

**Now 60¢**

### 7420 Dual 4 input NAND gate

Cat Z-5030 Was 50¢

**Now 30¢**

### 7430 8 input NAND gate

Cat Z-5035 Was 60¢

**Now 40¢**

### 7473 Dual J-K master/slave flip flop

Cat Z-5073 Was 60¢

**Now 40¢**

### 7476 Dual J-K master/slave flip flop

Cat Z-5076 Was 60¢

**Now 40¢**

### 7485 4 bit magnitude comparator

Cat Z-5085 Was \$1.10

**Now 65¢**

### 7486 Quad 2 input EXCLUSIVE-OR gate

Cat Z-5086 Was 70¢

**Now 50¢**

### 7490 Decade Counter

Cat Z-5090 Was 75¢

**Now 50¢**

### 7492 Divide by 12 counter

Cat Z-5092 Was 90¢

**Now 50¢**

### 7495 4 bit L-R shift register

Cat Z-5095 Was \$1.25

**Now 60¢**

### 74123 Dual re-triggerable monostable

Cat Z-5263 Was \$1.10

**Now 60¢**

### 74157 Quad 2 input multiplexer

Cat Z-5267 Was 75¢

**Now 50¢**

### GW Microswitch pack

Quality and value! For a variety of projects: on/off situations, 12V car alarms, movement sensors and more. Pk/10. Cat J-1036

**WAS \$3.95 \$2**

### Scotchlock UG Quick Connectors

Makes life so simple! Neatly and quickly secures wire connections on all projects. And so affordable too. Pk/10. Cat J-1020

**WAS 80¢ 40¢**

### UHF Helical Filters

High quality UHF Helical Filter (also known as helical resonators) — as used in our UHF amateur transceiver kit. Cat L-1850

**WAS \$7.95 \$4<sup>95</sup>**

### TV 'Ghost Killer' Antenna

Get the most from your expensive TV with this affordable antenna. Cat L-4030

**WAS \$79 \$59**

### Luminous Tabs

Find power point switches in the dark. Cat P-5350

**WAS \$1.99 99¢**

### Using Your IBM Personal Computer

All the 'low-down' on the working and capabilities of your IBM PC... from hardware to software. Cat X-8630

**WAS \$19.95 \$15**

### Wideband Op Amp

Draws little current, provides wide band width! Cat Z-6010

**WAS \$7.20 \$3<sup>50</sup>**

### LM1871N RC Encoder

Translates a digital language into code. Cat Z-6103

**WAS \$6.95 \$5**

### LM1872N RC Decoder

Converts received codes into plain language. Cat Z-6104

**WAS \$7.95 \$3<sup>95</sup>**

### Programming The Z80

Over 600 pages that provide an educational text and reference manual of machine language. Cat X-2364

**WAS \$19.95 \$15**

### Assembler Language Programming: IBM PC

Teaches you how an IBM PC works, about 8088 microprocessing, programming in assembler language and more! Cat X-8632

**WAS \$29.95 \$15**

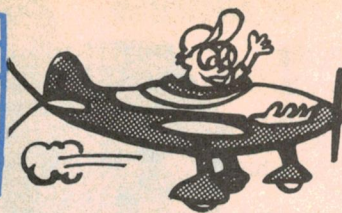
### Microcomputer Software Buyer's Guide Vol. 1 & 2

Over 300 pages with indepth coverage of major software packages for spread sheets, communications, database and graphics. Vol 1... Cat X-2371 Vol 2... Cat X-2372

**\$9<sup>95</sup>**

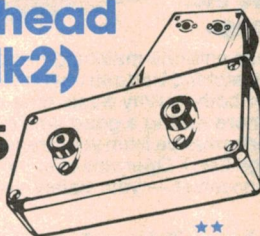


# KITS GALORE



## TV Masthead Amp (Mk2)

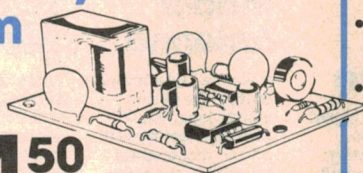
**\$34<sup>95</sup>**



Don't put up with lousy TV (we can't do much about the content, but this kit should fix the pix!) Reduces or even eliminates snow, great for reducing ghosting. Covers both UHF and VHF TV bands plus FM bands. Includes 240V supply in price. Cat K-3232

## Economy Car Alarm

**\$14<sup>50</sup>**



This alarm senses the voltage drop in your car's electrical system when a thief breaks into it. There's a visual warning for thieves so that chances are they will not even attempt a break-in. Easy to install saves a lot of trouble. Cat K-3250

## Negative Ion Generator

**\$34<sup>50</sup>**

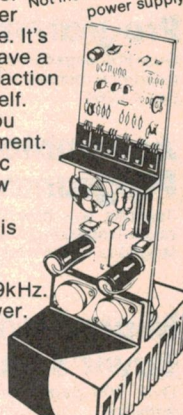


Employs a voltage multiplier with a DC voltage of approximately 8100 volts. Consists of 24 capacitor diode stages which multiply the 240V AC mains. The ionizer is housed in a plastic box to avoid the possibility of arcing which leads to the production of ozone. Cat K-3333

## 60W Mosfet Module

Improve the performance of your medium power amplifier with this affordable module. It's a kit, which means you'll save a bundle and have the satisfaction of saying you built it yourself. And what performance! You won't believe the improvement. Second and third harmonic distortion figures are below 0.001% at full power, and intermodulation distortion is below 0.003% at 10kHz. Frequency response is flat within  $\pm 0.4$ dB from 8Hz-29kHz. Noise is -100dB at full power. Cat K-3441

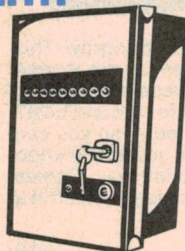
Not including power supply



**\$79<sup>95</sup>**

## Home Alarm

EA have thought of just about everything in the development of this design. It offers features which you'd normally find on \$200 and more commercial units (even ours!)



It offers:

- Security key operation for both alarm function and box access
- 2 instant and six delay sectors, capable of handling normally open or normally closed in any mix
- Inbuilt mains power supply with battery backup
- Siren (up to two speakers) PLUS bell (relay) output and also capable of driving telephone diallers, strobes, etc etc.
- Inbuilt local test facilities, including buzzer and we've made the EA design even better: a heavier steel case, for example. our kit includes our specially prepared instructions — so you won't have any problems!

Complete kit including case and all electronics.

Cat K-3424

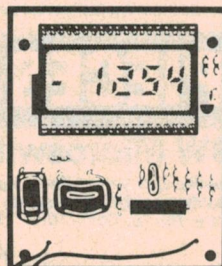
Battery to suit: 12 Volt 1.2Ah Gel Cell

Cat S-3315 \$22.50

**\$129**

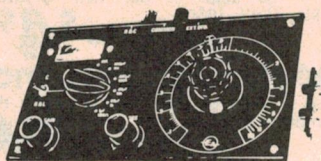
## LCD Panel Meter

**\$34<sup>95</sup>**



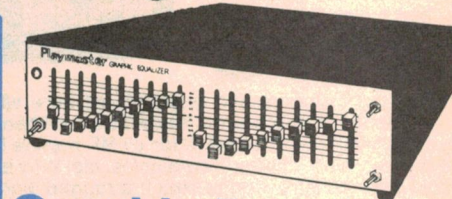
A versatile accurate panel meter using a large liquid crystal display for low power consumption. The PC board design allows for maximum flexibility to cater for varied mounting arrangements. The low cost makes it ideally suited as a readout device on many projects, at both amateur and professional level. Cat K-3450

## R-L-C Bridge



Measure the values of new and used components easily and simply. You can measure resistance (10 ohms to 10 Meg-ohms), capacitance (10pF to 10 uF) and inductance (down to a few hundred microhenries). Battery not supplied. Cat K-3468

**\$44<sup>50</sup>**



## Graphic Equaliser

Get total control and flexibility with your sound system. With cut and boost of up to 13dB per channel you can make up for deficiencies in your own listening area and sound source and even create special effects. (Big, booming bass: bewdy!) You can even make equalised tapes of those precious records. Featuring professional quality brushed aluminium front panel.

Cat K-3500

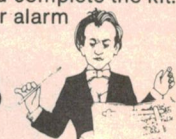
**ONLY \$129**

## Music Generator

This is a great little kit for the beginner or experimenter. It uses a very special IC which is pre-programmed with two very popular tunes: 'Green Sleeves' and 'Home on the Range'. It also has the popular 'ding dong' plus an alarm tone. A few more components and a printed circuit board complete the kit. It is intended for novelty or alarm applications.

Cat K-3512

**\$12<sup>95</sup>**



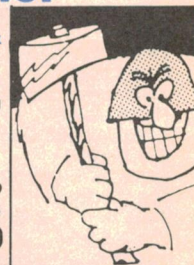
## Stereo TV Decoder

**\$199**

You have a choice of building the decoder with it's own power amplifiers — or you can simply feed the output into your hi fi stereo system to cut costs even further. The result: stereo TV sound you'll be proud of! And even more: included is a TV tuner which picks up UHF — so if your telly can't quite manage UHF, you're even further in front! Cat K-6325

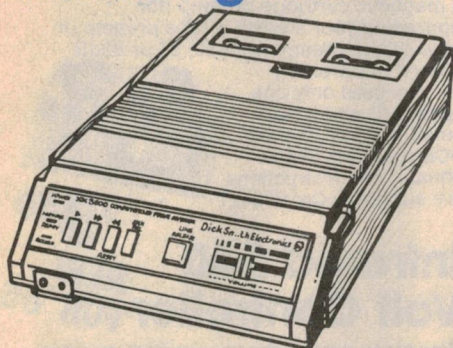
## Ignition Killer

Ingenious but simple circuit based on a 555 timer that literally kills your car ignition and then re-sets itself, making the thief think something is wrong with the engine. The theory is he'll then go and pinch someone else's car instead. Cat K-3255





## Two Tape Answering Machine 'Memory'



They said it couldn't be done... but we've actually improved our popular original two tape answering machine which has sold thousands over the past few years. This new model, incorporating absolutely the latest state-of-the-art design, stands head and shoulders above any other one or two tape machines available at any price!

Cat F-6135

Telecom Authorised

**\$299**

## Single Tape Answering Machine

Telecom Authorised



Cat F-6130

Imagining an economy single tape telephone answering machine with more advanced features than most dual taped machines! This fantastic machine has got to be the simplest of all to use... in fact, the solid state microprocessor circuitry is actually activated by the slide of a button. Revolutionary VOX (voice activated) remote control — no costly beepers required. Voice activated message time means more messages per tape and no wasted space. Unbelievable value!

**\$229**

## Wow! Phone For Under \$25

Own your phone... it's so inexpensive at DSE. This beauty has push button dialling, mute, redial and more. Ideal first or second phone.

Cat J-1027

**Bonus Phone Holder**

**\$24<sup>95</sup>**

## Thanks For The

Telecom Authorised



**\$129**

A phone that's a real time saver... program up to 80 numbers in memory for automatic single button dialling. PLUS a host of other impressive features:

- Electronic security lock
- Re-dial and mute buttons
- Access pause for PABX systems

Cat F-5165

## DSE's Own Feature Packed Cordless Phone



At home how many times has the phone rung while you've been resting by the pool, soaking in the bath... and all those other inconvenient moments? DSE's Cordless Phone ends all those problems! Take the remote handset with you, indoor and out, ready for any call: effective up to 100m.

Handset features modern push button dialling, redial, mute and volume control. Features 'Power On' and 'In Use' LED indicators, full duplex system for interference free conversations and programmable security to prevent unauthorised handset use.

Cat F-5816

**\$249**

Telecom Authorised

## 'Hands-Free' Push Button Memory Phone

**\$249**

Telecom Authorised



Nine-number memory allows quick one-button dialling of frequently used numbers. And if the last number dialled is engaged, one button 're-dial' function automatically redials the number: it's a real time saver! Use the mute button to ensure total privacy on important/personal calls. Features PABX or direct line operation, Earth key and Hookflash transfer plus switchable DTMF (tone) and Decadic (pulse). Ideal for either desk or wall mounting. Cat F-5135

## 10 Memory Phone

Our popular 10 Memory Telephone. No need to go searching for those elusive numbers. There're all here at the touch of a button. Has mute switch, auto redial and much more!

Cat F-5190

**\$29<sup>95</sup>**

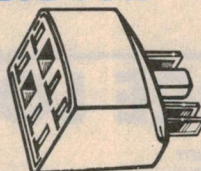


## ACCESSORIES

### DOUBLE ADAPTOR

Get away with it! Connect two phones or a phone and an answering machine without disconnecting and reconnecting.

Cat F-5112



TELECOM AUTHORISED

**\$14<sup>95</sup>**

### EXTEND YOURSELF...

Handy, inexpensive phone extension cords provide 'miles' of freedom to move the phone about the house or outside. Available in two sizes:

**WOW!**

10 metre  
Cat F-5115

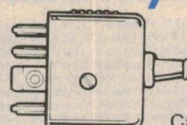
15 metre  
Cat F-5103



**ONLY \$15<sup>95</sup>**

**ONLY \$19<sup>95</sup>**

### PLUGS/SOCKETS



DSE's Telecom type 605 phone plugs... the right connection when installing your own phone.

Cat F-5117

Our 610 phone sockets are designed to Telecom standard... and DSE's versatility: ideal for use with double adaptors.

Cat F-5118

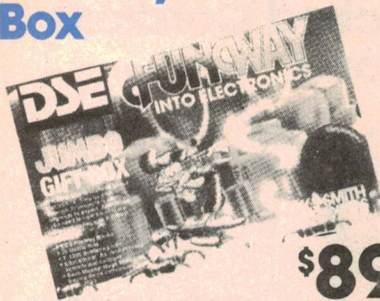


**\$3<sup>95</sup> ea.**

**TELECOM AUTHORISED SEE THE FULL RANGE OF DSE PHONES AND ACCESSORIES AT YOUR NEAREST DSE STORE!**



## Funway Jumbo Gift Microwave Box



**\$89<sup>95</sup>**

Here's even bigger value! This pack isn't called the Jumbo pack for nothing: it's chocka-bloc with over 30 projects and a quality soldering iron to build them all. Almost \$100 value at a price most parents can afford... and what price can you place on your children's future. This may be the best gift a parent can give. Cat K-2690

## Pre-scaler

Improve the performance and increase the range of your K-3439 Frequency Counter to a more professional range of operation... 10-500MHz. This kit adapts to the existing frequency counter PC board. Cat K-3432 **\$34<sup>50</sup>**

## Leakage Detector

**\$14<sup>95</sup>**

Microwave ovens are fantastic - but are they completely safe? Yours could be leaking dangerous radiation! Check it out with this handy meter. No batteries required. Cat K-3095

## LED Tacho



Don't spend a fortune buying a tachometer - build your own and save! Displays engine speed in an analogue form in an illuminated row of LED's. Instructions included - a great kit! Cat K-3240

**ONLY \$24<sup>50</sup>**

## Stereo Preamplifier

The amazingly versatile unit can be built as a magnetic cartridge preamp (for upgrading your stereo), a tape preamp or an auxiliary preamp with 40, 55 or 80dB gain. It is extremely simple: uses only one special IC and is very small, all parts fit on a PCB less than 65mm square. Full instructions are supplied. Cat K-3427



**\$8<sup>50</sup>**

## Infrared 240 Volt Controller

How many times have you wanted to switch a power point 'ON' or 'OFF' when it's across the room? With this fantastic Infrared Remote Control switch, you can switch on the TV, lamp, radio or many mains appliances without moving from the comfort of your bed or chair.



**BARGAIN! \$69<sup>95</sup>**

## STORE LOCATIONS

### NSW

Swift & Young Sts.  
T55 Terrace Level  
Shop 1, 65-75 Main St  
613 Princess Hwy  
Oxford & Adelaide Sts  
531 Pittwater Rd  
Campbelltown Mall Queen St  
Shop 235, Archer St Entrance  
147 Hume Hwy  
164 Pacific Hwy  
315 Mann St  
4 Florence St  
Elizabeth Dr & Bathurst St  
450 High Street  
621-627 The Kingsway  
173 Maitland Rd, Tighes Hill  
Lane Cove & Waterloo Rds  
George & Smith Sts  
The Gateway High & Henry Sts  
818 George St  
125 York St  
Telcor's Bldg, Brisbane St  
263 Keira St

**Albury** (060) 21 8399  
**Bankstown Sq** (02) 707 4888  
**Blacktown** (02) 671 7722  
**Blakehurst** (02) 546 7744  
**Bondi Junction** (02) 387 1444  
**Brookvale** (02) 93 0441  
**Campbelltown** (046) 27 2199  
**Chatswood Chase** (02) 411 1955  
**Chullora** (02) 642 8922  
**Gore Hill** (02) 439 5311  
**Gosford** (043) 25 0235  
**Hornsby** (02) 477 6633  
**Liverpool** (02) 800 9888  
**Maitland** (049) 33 7866  
**Miranda** (02) TBA  
**Newcastle** (049) 81 1896  
**North Ryde** (02) 88 3955  
**Parramatta** (02) 689 2188  
**Penrith** (047) 32 3400  
**Railway Square** (02) 211 3777  
**Sydney City** (02) 267 9111  
**Tamworth** (067) 66 1711  
**Wollongong** (042) 28 3800

### ACT

96 Gladstone St  
Creswick Rd & Webster St  
145 McCrae St  
Shop 46, Box Hill Central, Main St  
Hawthorn Rd & Nepean Hwy  
260 Sydney Rd  
1150 Mt Alexander Rd  
Nepean Hwy & Ross Smith Ave  
Shop 9 110, High St  
291-293 Elizabeth St  
Bridge Rd & The Boulevard  
Springvale & Dandenong Rds  
**QLD**  
157-159 Elizabeth St  
166 Logan Rd  
Gympie & Hamilton Rds  
Queen Elizabeth Dr & Bernard St  
Gold Coast Hwy & Welch St  
Bowen & Ruthven Sts  
Kings Rd & Woolcock St  
Cnr Pacific Hwy & Kingston Rd

### Fyshwick

**Ballarat** (053) 31 5433  
**Bendigo** (054) 43 0388  
**Box Hill** (03) 890 0699  
**East Brighton** (03) 592 2366  
**Coburg** (03) 383 4455  
**Essendon** (03) 379 7444  
**Frankston** (03) 783 9144  
**Geelong** (052) 43 8522  
**Melbourne City** (03) 67 9834  
**Richmond** (03) 428 1614  
**Springvale** (03) 547 0522  
**Brisbane City** (07) 229 9377  
**Buranda** (07) 391 6233  
**Chermside** (07) 359 6255  
**Rockhampton** (079) 27 9644  
**Southport** (075) 32 9863  
**Toowoomba** (076) 38 4300  
**Townsville** (077) 72 5722  
**Underwood** (07) 341 0844

### SA

Wright & Market Sts  
Main South & Flagstaff Rds  
Main North Rd & Darlington St  
24 Park Terrace  
**WA**  
Wharf St & Albany Hwy  
66 Adelaide St  
William St & Robinson Ave  
Raine Square, 125 William St  
**TAS**  
25 Barrack St  
**NT**  
17 Stuart Hwy

**Adelaide** (08) 212 1962  
**Darlington** (08) 298 8977  
**Enfield** (08) 260 6088  
**Salisbury** (08) 281 1593  
**Cannington** (09) 451 8666  
**Fremantle** (09) 335 9733  
**North Perth** (09) 328 6944  
**Perth City** (09) 481 3261  
**Hobart** (002) 31 0800  
**Stuart Park** (089) 81 1977

### Dear Customers,

Quite often, the products we advertise are so popular they run out within a few days, or unforeseen circumstances might hold up shipments so that advertised lines are not in the stores by the time the advert appears. And very occasionally, an error might slip through our checks and appear in the advert (after all, we're human too!) Please don't blame the store manager or staff: they cannot solve a dock strike on the other side of the world, nor fix an error that's appeared in print. If you're about to drive across town to pick up an advertised line, why not play it safe and give them a call first... just in case! Thanks. Dick Smith Electronics.

### MAJOR DICK SMITH ELECTRONICS AUTHORISED RESELLERS

**NSW:** • Ballina: A. Cummings & Co. 91-93 River St 86 2284 • Ulladulla: Pauls Electronics, 10 Wason Street, 55 3989 • Bowral: F.R.H. Electrical, 28 Station St 61 1861 • Broken Hill: Hobbies & Electronics, 31 Oxide St 88 4098 • Charlestown: Newtronics 131 Pacific Hwy 43 9600 • Coffs Harbour: Coffs Harbour Electronics, 3 Coffs Plaza, Park Ave. 56 5684 • Deniliquin: Deni Electronics, 220 Cressy St, 81 3672 • Gosford: Tomorrows Electronics & HiFi, 68 William St, 24 7246 • Lismore: Decro 3A/6-18 Carrington St, 21 4137 • Port Macquarie: Hall of Electronics, Horton Centre, Horton St, 83 7440 • Orange: Fyfe Electronics 173 Summer St, 62 6491 • Tumut: Tumut Electronics Wynyard St, 47 1631 • Tweed Heads: Stuart Street Electronic Sales, Stuart St, 367 5744 • Swansea: Swansea Electronics, 184 High St, 71 1674 • Wagga: Phillips Electronics 82 Forsyth St, 21 6555 • Windsor: M & E Electronics, Sh 7, McEwans Arcade, 206 George St, 77 5935 • Young: Keith Donges Electronics 186 Boorowa St 82 1279 **VIC:** • Hamilton: John Thompson & Co, 138-148 Gray St, 72 2000 • **Echuca:** Webster Electronics, 220 Packham St 82 2956 • **Mildura:** McWilliams Electronics 110A Langtree Ave, 23 6410 • **Morwell:** Morwell Electronics, 95 George St, 34 6133 • **Shepparton:** GV Electronics Centre 100 High St, 21 8866 **QLD:** • **Bundaberg:** Bob Elkin Electronics, 81 Bourbong St, 51 1723 • **Maryborough:** Keller Electronics, 218 Adelaide St, 21 4559 • **Mt Isa:** Outback Electronics Shop 71 Barkley Hwy 43 3331 • **Rockhampton:** Purely Electronics, 15 East St, 21 058 **SA:** • **Mt Gambier:** Hutchessons Communications, 5 Elizabeth St, 25 6404 • **Whyalla:** Eyre Electronics Shop 2 Forsythe St, 45 4764 **WA:** • **Albany:** Micro Electronics 133 Lockyer Ave 41 3432 **TAS:** • **Launceston:** Willis Electronics SA The Quadrant, 31 5688

## DSX PRESS ORDER SERVICE

Use your Bankcard, Mastercard or Visacard.  
Just Phone **008 226610** (toll free) for, despatch of your orders. Enquiries: By mail or phone (02) 888 2105  
Fax (02) 888 3631 Telex AA20036

POST & PACKING CHARGES	Order Value	Charge	Order Value	Charge
	\$5.00 - \$9.99	\$2.00	\$50.00 - \$75.00	\$6.50
	\$10.00 - \$24.99	\$3.50	\$75.00 or more	N.A.
	\$25.00 - \$49.99	\$4.50		

Terms available to approved applicants

SA Customers: Credit facilities available through Adelaide: 10 Pulteney St. Adelaide



PTY LTD

P.O. Box 321, North Ryde N.S.W. 2113. Tel: 888 3200



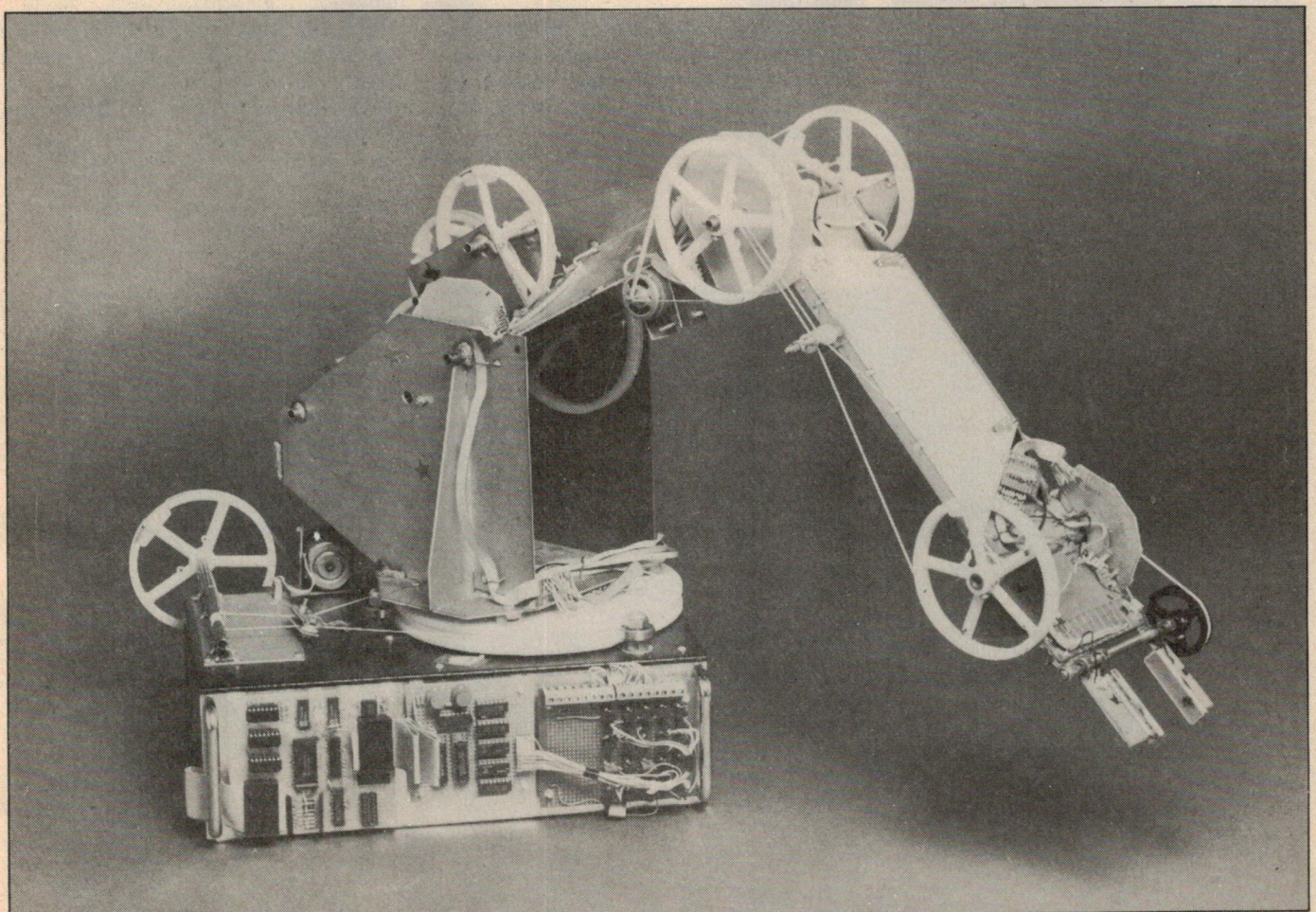
# Algernon

## a low cost robot for any 8-bit computer

### Pt.3

*Here's the third and final article on Algernon, the low cost robot fabricated from copper clad phenolic board. In this, we wrap up details of the circuit assembly and review the control program.*

The development of this project by the designer, Ray Pakalns, together with the sponsoring company, Jaycar Electronics, has proved to be a much larger undertaking than was initially foreseen. It is only now that the amount of work necessary to complete the project has been realised.



This photo shows the original prototype with the PCBs mounted on the outside of the base for access.



# Algernon

Finally though, the development work on Algernon is complete, at least as far as the mechanicals and the interface details for the Microbee are concerned. But it is clear that the project has lots of potential for further development to allow it to be interfaced with other 8-bit computers. There is also a lot of scope for software development, to suit it to various computers and to produce a variety of operating routines.

At the time of writing this final article, Ray Pakalns has just completed the comprehensive assembly manual for the project. It is a very creditable production running to over 80 foolscap pages in which every facet of the project is discussed. This manual will be available on its own from Jaycar stores at the very reasonable price of \$10.00. This gives all the information needed to build the robot except for the copper patterns of the sensor discs and circuit boards.

Included in the manual are the full cutting and assembly details for the various copper clad sections of the robot and we can well imagine some constructors buying just the manual, the essential PC boards and some of the hardware such as the dial drive pulleys

and motors and then building the rest of the robot completely from scratch.

We certainly wish that we could have had access to the manual when we assembled our prototype because it answers so many questions that we had to resolve the hard way, by trial and error.

Ray Pakalns has also written a preliminary program in Basic to put Algernon through a series of simple movements, controlled via the Microbee. Ultimately, Jaycar will be supplying a more refined version of this program, written largely in machine code. This will greatly increase the operating speed of the robot which otherwise tends to be on the leisurely side.

With the simple routines on the supplied program it will be possible for constructors to develop their own operating programs to put Algernon through complex routines.

A facility to control the speed of each motor is also included in the supplied program, with speeds 0 to 9 available. The lowest setting means that the motor will only creep in a series of short pulses, while the speed of the highest setting is determined by the load and gear ratio.

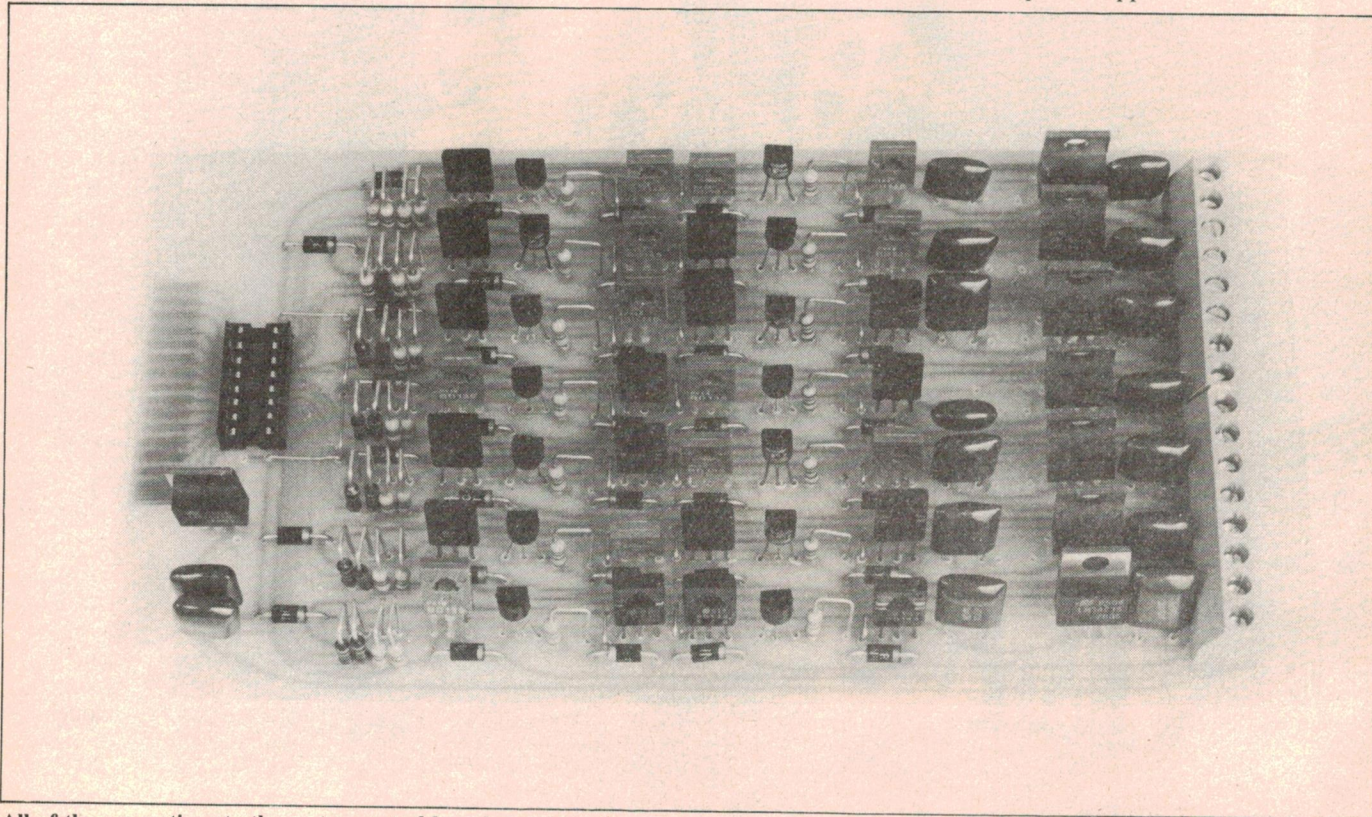
In setting a sequence of movements, the programmer must manually operate the robot to every required position in the sequence. This is done via the Microbee keyboard.

At each desired position, operating the "S" (store) key of the keyboard memorizes the position. What is memorized is the coded data from each of the sensor discs. As the data for most of the discs is picked up through three pin contacts, it is possible that one of the pins may be between pads on the disc. This would lead to an invalid input. The program will not permit this, causing the joint to shuffle minutely until a proper code is generated.

An initial program written to make Algernon pick up a small box brought to light an interesting problem. The eight-bit gripper sensor did not have sufficient resolution to grasp the box properly. The robot attempted to close the grippers too tightly, so that eventually, the rubber band drive acted as a clutch, with the motor continuing to spin.

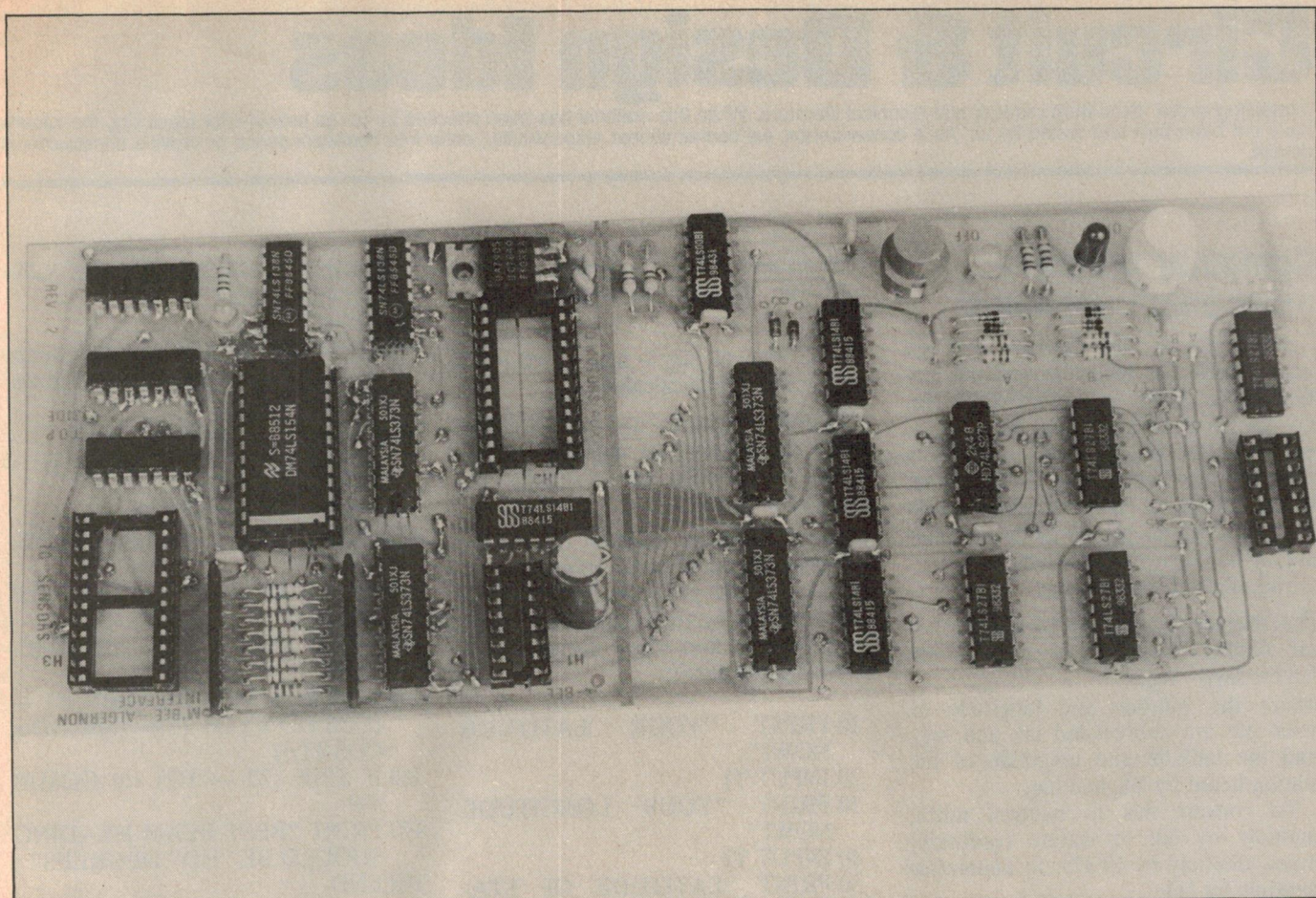
The problem here was due to the fact that the program did not have any conditional statement. It could look at either the gripper position or the tactile sensor output, but it could not combine data from both. The net result was that it attempted to close the grippers too tightly.

With the final program, this problem will be solved with a control sequence which will close the grippers to the specified position unless the tactile sensor output is tripped.



All of the connections to the motor control board are made through a 16-pin header and a 16-way terminal block.





The interface board includes interlock circuitry to prevent forward and reverse from being engaged simultaneously.

## Interface and control circuits

The interface and control circuits are reasonably straightforward. Since the Microbee performs all the decoding and sequencing, the Algernon electronics are only needed for buffering, interlock and power.

There are actually two PCBs which must be built up for the robot — one is the power board with the motor drive transistors and the other is the interface circuit. The interface board is the more complicated of the two, being a double-sided board measuring 224 x 90mm. Two main functions are performed by this board, multiplexing the coded sensor information and latching motor control.

Without multiplexing, the amount of wiring and circuitry required would otherwise get out of hand. As it is, an 8-bit data bus is shared by five sensors.

Multiplexing is performed by a 74LS154 4-line to 16-line decoder. Depending on the 4-bit input code, one of 16 outputs will be enabled. Only 13 of the 16 outputs are used in the standard robot: three outputs are connected to

each of the waist, shoulder and elbow sensors; two are connected to the wrist; and one each to the gripper and touch sensors.

It is advisable to wire the robot as per the manual to avoid erroneous multiplexing signals. With the correct wiring, the computer, via the 74LS54, sequentially enables all of the sensor wipers.

Data is fed via eight diodes on each sensor disc to the data bus. This is connected directly to the Microbee parallel input bus. The program analyses the input data and performs the necessary calculations to determine each sensor position.

The Microbee control signals are latched by two 74LS373 octal Tristate latches. Two of these are needed to latch the 16 control lines.

To prevent forward and reverse from being engaged simultaneously for each motor, the latched outputs are fed through an interlock circuit. This consists of three 74LS14 hex Schmitt triggers in conjunction with three 74LS27 triple 3-input NOR gates.

The low speed options on the board are provided by two oscillators each

built around 74LS14 Schmitt triggers. By tailoring the component values the particular duty cycle can be selected to suit any requirement. Each of the low speed options can be used with up to three of the motors. Keyboard controls are used to select the required low speed mode.

The motor control board (180 x 95mm) is single sided. It has 42 transistors and eight regulators, not to mention a few other parts. The board is rather neat, with all of the components set out in rows. Further, connections are made either through a 16-pin header or 16-way terminal block.

Our version of the Algernon had the interface board on the outside of the metal box to allow access. The recommended method though is to mount the boards inside the box — it's a lot neater.

The circuits of the interface and control boards are fully detailed in the manual described above. Although a low cost robot, the design has certainly meant a big investment in time and money. We think it will be very popular with computer enthusiasts.



# Circuit & Design Ideas

Interesting circuit ideas from readers and technical literature. While this material has been checked as far as possible for feasibility, the circuits have not been built and tested by us. As a consequence, we cannot accept responsibility, enter into correspondence or provide constructional details.

## Computer program aims beam antennas

Just what is the distance between your station (or receiver) and the station you're working or receiving? No, not the road distance, the direct shortest distance which shows up on a Mercator Projection map as the Great Circle Distance. What heading would the beam best be set at? Both questions are answered by this program.

The relevant formulas are:

(1) Distance (in 'degrees of latitude') =  $\arccos[\sin \text{lat}_s \sin \text{lat}_h + \cos \text{lat}_s \cos \text{lat}_h \cos(\text{lng}_h - \text{lng}_s)]$

where the latitude and longitude of your site are abbreviated  $\text{lat}_s$  and  $\text{lng}_s$ , and the latitude and longitude of the station heard by  $\text{lat}_h$  and  $\text{lng}_h$ .

To convert this to nautical miles, multiply by 60; to statute (ordinary) miles, multiply by 69.375; to kilometres multiply by 111.

(2) Beam heading =  $\arccos(((\sin \text{lat}_h -$

$(\cos(\text{distance 'in degrees'}) \times \cos \text{lat}_s)) / (\sin \text{distance 'in degrees'}) \times \cos \text{lat}_h))$

If the sine of  $\text{lng}_s - \text{lng}_h$  is  $< 0$ , then  $\text{hdg} = 360^\circ - \text{hdg calculated}$ .

Eastern longitudes and southern latitudes are entered as negative values, western longitudes and northern latitudes as positive.

There are many 'dialects' of BASIC, the language most home computers accept so, if the program which follows isn't accepted by your computer, consult its manual to find which instructions it doesn't understand!

```
10 PRINT "YOUR LATITUDE
NOW?"
20 INPUT T1
30 PRINT "YOUR LONGITUDE
NOW?"
40 INPUT T2
50 PRINT "LATITUDE OF STA-
TION HEARD?"
60 INPUT H1
```

```
70 PRINT "LONGITUDE OF STA-
TION HEARD?"
```

```
80 INPUT H2
```

```
90 REM enter latitudes and longitudes
in degrees and decimally-divided de-
grees.
```

```
100 LET DD = ARCCOS [(SIN T1 x
SIN H1) + (COS T1 x COS H1 x
COS (H2 - T2))]
```

```
110 PRINT "DISTANCE IS:"
```

```
120 PRINT (DD x 60 "NAUTICAL
MILES"
```

```
130 PRINT (DD x 69.375) "STATUTE
MILES"
```

```
140 PRINT (DD x 111) "KILOME-
TRES"
```

```
150 Let HD = ARCCOS (((SIN H1 -
COS DD x COS T1)) / (SIN DD x
COS T1)))
```

```
160 If SINE (T2 - H2) < 0 GOSUB
500
```

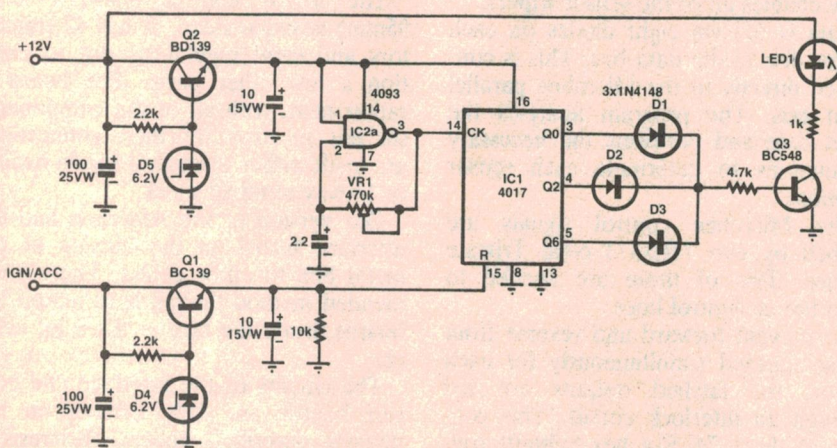
```
170 PRINT "BEST BEAM HEADING
SHOULD BE "HD" DEGREES"
```

```
180 END
```

I. Compton,  
Richmond, S.A.

**\$20**

## Burglar alarm deterrent flasher



Most burglar alarm flashers simply flash on and off with a duty cycle of about 50%. If you want something a little different, this circuit will do the job — when activated, the lamp flashes twice, then once, then twice and so on.

IC1 is a 4017 decade counter and is clocked by Schmitt trigger oscillator IC2a with frequency set by trimmer VR1. Assuming power is applied, the Q0, Q2 and Q6 outputs of IC1 pulse high in turn. These outputs are ORed by diodes D1-D3 and drive transistor Q3 to flash the LED.

Q2, in conjunction with zener diode D5, provides a regulated 5.6V supply for the CMOS ICs. Q1 and D4 work in a similar fashion. When the ignition switch is turned on, pin 15 (reset) of IC1 is held high and the flasher is disabled.

P. Howarth,  
Gunnedah, NSW.

**\$15**



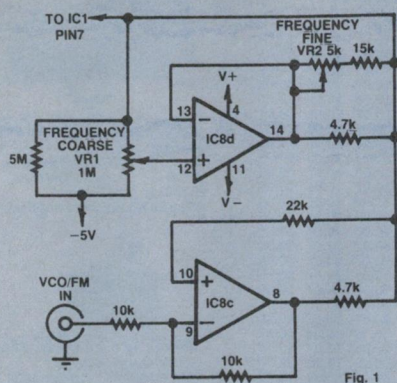


Fig. 1

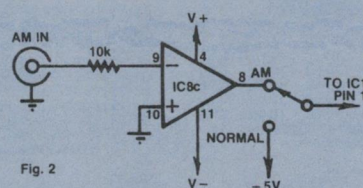


Fig. 2

## FM and AM modulation for the EA Function Generator

These two circuits allow frequency or amplitude modulation of the output of the EA Function Generator (April 1982).

Basically, Fig.1 and Fig.2 are modifications of the Function Generator Enhancement described in June 1984. In each case, op amp IC8c buffers the variable voltage source for the FM or AM

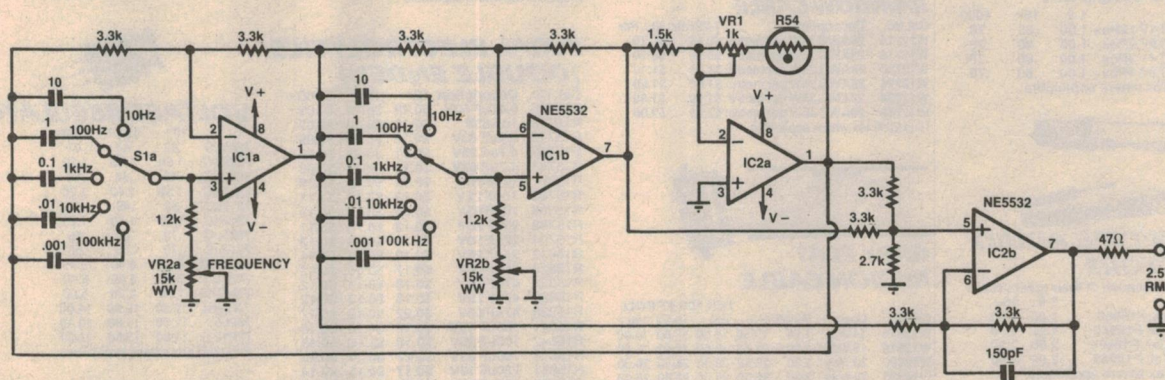
input.

In the frequency modulation circuit (Fig.1), the coarse frequency control circuit is modified to compensate for the removal of IC8c. The coarse and fine controls still operate in a similar manner to those in the original enhancement circuit, but with the added facility of the FM input.

The amplitude modulation circuit (Fig.2) uses IC8c to buffer input voltage signals to the AM modulation input of the function generator chip, IC1. A single-pole 2-position switch enables or disables the AM input.

B. Paterson,  
Glen Iris, Vic.

**\$15**



## High performance audio generator

This simple sine wave oscillator has performance superior to all but the most expensive commercial units. It covers the frequency range from 1Hz to 100Hz and there is no amplitude bounce when the frequency is varied. Total harmonic distortion is less than .005% from 20Hz to 20kHz, and less than .0015% at 1kHz.

The circuit is based on one that appeared in *Wireless World*, February 1982. Phase shifters IC1a and IC1b, to-

gether with inverting stage IC2a, form a sine wave oscillator, while IC2b cancels the third harmonic generated at the output of IC2a due to the non-linearity of the R54 thermistor.

The frequency is adjusted by means of VR2 which is a 15kΩ dual-gang wirewound trimpot. Double-pole rotary switch S1 provides the range switching.

The unit should be powered from well-regulated  $\pm 12V$  supply rails while multiturn trimpot VR1 should be set for a 2.5V RMS output. Note that NE5534 ICs can be used if the NE5532s are hard to get. All resistors and capacitors

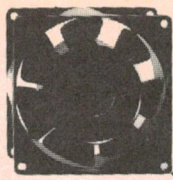
should be 1% types if possible.

Phil Allison,  
Summer Hill, NSW

**\$25**

Editor's note: in practice, a 15kΩ dual-gang wirewound potentiometer may be difficult to obtain. A conventional pot should not be substituted, however — its tracking accuracy will not be good enough. One way around the problem is to substitute two strings of 1% resistors for the potentiometer elements, and to switch these into circuit to provide a range of spot frequencies using a 2-pole multi-position rotary switch.





## FANS

Cat. No.	Description	1-9	10+	100+
Cat. T12461	240V 4 1/2"	10.50	10.00	8.00
Cat. T12465	240V 3 1/2"	10.50	10.00	8.00
Cat. T12463	115V 4 1/2"	10.50	10.00	8.00
Cat. T12467	115V 3 1/2"	10.50	10.00	8.00

(Fan guards to suit also available)  
Plus 20% tax where applicable



## ECONOMY TOGGLE SWITCHES

Unbelievable Value!

Cat. No.	Description	10-99	100+
S11010 (SPDT)		0.70	0.60
S11020 (DPDT)		0.90	0.80

Plus 20% Sales Tax where applicable



## QUALITY MOMENTARY (RED BODY)

Cat. No.	Description	10-99	100+
SPDT Cat. S11050		1.00	.90

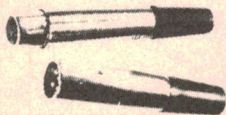
Plus 20% Sales Tax where applicable



## ENCLOSED ROTARY SWITCHES AT SPECIAL PRICES!!

Cat. No.	Description	1-9	10+	100+
S13021	SW ROT 1P 12Pos	1.00	.80	.70
S13022	SW ROT 2P 6Pos	1.00	.80	.70
S13033	SW ROT 4P 3Pos	1.00	.80	.70
S13035	SW ROT 3P 4Pos	1.00	.80	.70

Plus 20% Sales Tax where applicable

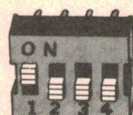


## CANNON TYPE AUDIO CONNECTORS

We've sold 1000's because of their great value!

Cat. No.	Description	1-9	10+	100+
3 Pin Line male Cat. P10960		1.80	1.60	
3 Pin Chas male Cat. P10962		1.90	1.70	
3 Pin line female Cat. P10964		2.50	2.20	
3 Pin Chas FMe Cat. P10966		2.90	2.50	

Plus 20% Sales Tax where applicable



## DIP SWITCHES

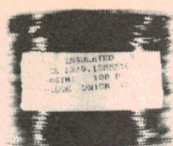
Cat. No.	Description	10+	100+	1000+
S13402 2 Way		.70	.65	.60
S13404 4 Way		.90	.75	.70
S13405 5 Way		.90	.85	.80
S13407 7 Way		1.10	1.00	.95
S13408 8 Way		1.20	1.10	1.00

20% Sales tax where applicable

## ELECTROLYTICS

Cat. No.	Description	10+	100+
R1415	1uF 63V PCB RB	0.05	0.04
R15461	10uF 16V PCB RB	0.05	0.04
R15462	10uF 25V PCB RB	0.05	0.04
R15462	22uF 25V PCB RB	0.06	0.05
R15521	47uF 16V PCB RB	0.07	0.06
R15522	47uF 25V PCB RB	0.08	0.07
R15581	1000uF 16V PCB RB	0.21	0.20
R15582	1000uF 25V PCB RB	0.28	0.25
R15591	2200uF 16V PCB RB	0.39	0.33
R15592	2200uF 25V PCB RB	0.55	0.50
R15904	2200uF 50V AXIAL	1.50	1.00

Plus 30% tax where applicable



## HOOK UP WIRE

Cat. No.	Description	1-9	10+
W11251	13/12 TND BLK		
W11252	13/12 TLD BROWN		
W11253	13/12 TLD ORANGE		
W11254	13/12 TLD YELLOW		
W11255	13/12 TLD GREEN		
W11256	13/12 TLD BLUE		
W11257	13/12 TLD WHITE		

PRICES PER 100 METRE ROLL

Cat. No.	Description	1-9	10+
W11260	14/20 RED	\$3.50	\$3.00
W11261	14/20 BLACK		
W11265	14/20 BLUE		
W11268	14/20 WHITE		

PRICES PER 100 METRE ROLL

Cat. No.	Description	1-9	10+
W11270	24/20 RED	\$9.00	\$7.00
W11272	24/20 BLACK		
W11274	24/20 GREEN		

PRICES PER 100 METRE ROLL

Cat. No.	Description	1-9	10+
W11280	32/2 BROWN	\$11.00	\$10.00
W11282	32/2 BLUE		

PRICES PER 100 METRE ROLL

Cat. No.	Description	1-9	10+
W11280	32/2 BROWN	\$12.00	\$11.00
W11282	32/2 BLUE		

PRICES PER 100 METRE ROLL

Cat. No.	Description	1-9	10+
W11280	32/2 BROWN	\$12.00	\$11.00
W11282	32/2 BLUE		

PRICES PER 100 METRE ROLL

Cat. No.	Description	1-9	10+
W11280	32/2 BROWN	\$12.00	\$11.00
W11282	32/2 BLUE		

PRICES PER 100 METRE ROLL

Cat. No.	Description	1-9	10+
W11280	32/2 BROWN	\$12.00	\$11.00
W11282	32/2 BLUE		

PRICES PER 100 METRE ROLL

Cat. No.	Description	1-9	10+
W11280	32/2 BROWN	\$12.00	\$11.00
W11282	32/2 BLUE		

PRICES PER 100 METRE ROLL

Cat. No.	Description	1-9	10+
W11280	32/2 BROWN	\$12.00	\$11.00
W11282	32/2 BLUE		

PRICES PER 100 METRE ROLL

Cat. No.	Description	1-9	10+
W11280	32/2 BROWN	\$12.00	\$11.00
W11282	32/2 BLUE		

PRICES PER 100 METRE ROLL

Cat. No.	Description	1-9	10+
W11280	32/2 BROWN	\$12.00	\$11.00
W11282	32/2 BLUE		

PRICES PER 100 METRE ROLL

Cat. No.	Description	1-9	10+
W11280	32/2 BROWN	\$12.00	\$11.00
W11282	32/2 BLUE		

PRICES PER 100 METRE ROLL

Cat. No.	Description	1-9	10+
W11280	32/2 BROWN	\$12.00	\$11.00
W11282	32/2 BLUE		

PRICES PER 100 METRE ROLL

Cat. No.	Description	1-9	10+
W11280	32/2 BROWN	\$12.00	\$11.00
W11282	32/2 BLUE		

PRICES PER 100 METRE ROLL

Cat. No.	Description	1-9	10+
W11280	32/2 BROWN	\$12.00	\$11.00
W11282	32/2 BLUE		

PRICES PER 100 METRE ROLL

Cat. No.	Description	1-9	10+
W11280	32/2 BROWN	\$12.00	\$11.00
W11282	32/2 BLUE		

PRICES PER 100 METRE ROLL

Cat. No.	Description	1-9	10+
W11280	32/2 BROWN	\$12.00	\$11.00
W11282	32/2 BLUE		

PRICES PER 100 METRE ROLL

Cat. No.	Description	1-9	10+
W11280	32/2 BROWN	\$12.00	\$11.00
W11282	32/2 BLUE		

PRICES PER 100 METRE ROLL

Cat. No.	Description	1-9	10+
W11280	32/2 BROWN	\$12.00	\$11.00
W11282	32/2 BLUE		

PRICES PER 100 METRE ROLL

Cat. No.	Description	1-9	10+
W11280	32/2 BROWN	\$12.00	\$11.00
W11282	32/2 BLUE		

PRICES PER 100 METRE ROLL

Cat. No.	Description	1-9	10+
W11280	32/2 BROWN	\$12.00	\$11.00
W11282	32/2 BLUE		

PRICES PER 100 METRE ROLL

Cat. No.	Description	1-9	10+
W11280	32/2 BROWN	\$12.00	\$11.00
W11282	32/2 BLUE		

PRICES PER 100 METRE ROLL

Cat. No.	Description	1-9	10+
W11280	32/2 BROWN	\$12.00	\$11.00
W11282	32/2 BLUE		

PRICES PER 100 METRE ROLL

Cat. No.	Description	1-9	10+
W11280	32/2 BROWN	\$12.00	\$11.00
W11282	32/2 BLUE		

PRICES PER 100 METRE ROLL

Cat. No.	Description	1-9	10+
W11280	32/2 BROWN	\$12.00	\$11.00
W11282	32/2 BLUE		

PRICES PER 100 METRE ROLL

Cat. No.	Description	1-9	10+
W11280	32/2 BROWN	\$12.00	\$11.00
W11282	32/2 BLUE		

PRICES PER 100 METRE ROLL

Cat. No.	Description	1-9	10+
W11280	32/2 BROWN	\$12.00	\$11.00
W11282	32/2 BLUE		

PRICES PER 100 METRE ROLL

## ELECTROLYTIC SINGLE ENDED PCB MOUNT

Cat. No.	Description	10+	100+	1,000+
R15405	0.47uF 63V	\$0.07	\$0.06	\$0.05
R15415	1uF 63V	\$0.07	\$0.06	\$0.05
R15422	2.2uF 25V	\$0.07	\$0.06	\$0.05
R15424	2.2uF 50V	\$0.06	\$0.05	\$0.04
R15425	2.2uF 63V	\$0.07	\$0.06	\$0.05
R15432	3.3uF 25V	\$0.07	\$0.06	\$0.05
R15435	3.3uF 63V	\$0.07	\$0.06	\$0.05
R15442	4.7uF 25V	\$0.07	\$0.06	\$0.05
R15443	4.7uF 35V	\$0.08	\$0.07	\$0.06
R15445	4.7uF 63V	\$0.07	\$0.06	\$0.05
R15461	10uF 16V	\$0.07	\$0.06	\$0.05
R15462	10uF 25V	\$0.07	\$0.06	\$0.05
R15463	10uF 35V	\$0.07	\$0.06	\$0.05
R15465	10uF 63V	\$0.07	\$0.06	\$0.05
R15481	22uF 16V	\$0.07	\$0.06	\$0.05
R15482	22uF 25V	\$0.08	\$0.06	\$0.05
R15483	22uF 35V	\$0.08	\$0.07	\$0.06
R15484	22uF 50V	\$0.09	\$0.08	\$0.07
R15502	25uF 25V	\$0.07	\$0.06	\$0.05
R15505	25uF 63V	\$0.10	\$0.08	\$0.07
R15512	33uF 25V	\$0.08	\$0.07	\$0.06
R15521	47uF 16V	\$0.09	\$0.08	\$0.07
R15522	47uF 25V	\$0.09	\$0.08	\$0.07
R15525	47uF 63V	\$0.10	\$0.09	\$0.08
R15531	100uF 16V	\$0.10	\$0.09	\$0.09
R15532	100uF 25V	\$0.08	\$0.07	\$0.06
R15533	100uF 35V	\$0.15	\$0.12	\$0.11
R15535	100uF 63V	\$0.24	\$0.22	\$0.20
R15541	220uF 16V	\$0.09	\$0.08	\$0.07
R15542	220uF 25V	\$0.14	\$0.12	\$0.11
R15543	220uF 35V	\$0.25	\$0.23	\$0.20
R15545	220uF 63V	\$0.26	\$0.24	\$0.22
R15552	330uF 25V	\$0.15	\$0.13	\$0.12
R15555	330uF 63V	\$0.34	\$0.30	\$0.28
R15561	470uF 16V	\$0.16	\$0.13	\$0.12
R15562	470uF 25V	\$0.23	\$0.20	\$0.18
R15563	470uF 35V	\$0.30	\$0.28	\$0.26
R15564	470uF 50V	\$0.00	\$0.00	\$0.00
R15565	470uF 63V	\$0.44	\$0.39	\$0.36
R15581	1000uF 16V	\$0.25	\$0.22	\$0.20
R15582	1000uF 25V	\$0.35	\$0.30	\$0.28
R15583	1000uF 35V	\$0.45	\$0.40	\$0.36
R15591	2200uF 16V	\$0.45	\$0.40	\$0.36
R15592	2200uF 25V	\$0.65	\$0.60	\$0.50
R15593	2200uF 35V	\$1.20	\$0.91	\$0.75
R15601	2500uF 16V	\$0.45	\$0.40	\$0.36
R15602	2500uF 25V	\$0.65	\$0.60	\$0.55

Plus 10% tax where applicable

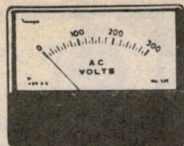
## BRIDGES

Cat. No.	Description	10+	100+	1000+	10K+
6A 400V		1.00	0.80	0.75	0.69
W02		0.24	0.23	0.20	0.18
W04		0.25	0.24	0.21	0.19

NEW MDA3504 BRIDGE!

Cat. No.	Description	10+	100+	100
----------	-------------	-----	------	-----





## PANEL METERS

		1-9	10+	100+
Q10500	MU450-1mA	6.95	6.75	6.50
Q10502	MU450-0-50uA	6.95	6.75	6.50
Q10504	MU450-0-100uA	6.95	6.75	6.50
Q10505	MU450-0-50uA	6.95	6.75	6.50
Q10510	MU450-0-5A	6.95	6.75	6.50
Q10518	MU450-0-1A	6.95	6.75	6.50
Q10520	MU450-0-20V	6.95	6.75	6.50
Q10535	MU450 VU	7.95	7.75	7.50
Q10530	MU520-0-1mA	9.95	8.35	
Q10533	MU520-0-5mA	9.95	8.35	
Q10538	MU650-0-50uA	9.35	8.95	8.75
Q10540	MU650-0-1mA	9.35	8.95	8.75
Q10550	MU650-0-100uA	9.35	8.95	8.75
Q10560	MU650-0-20V	9.35	8.95	8.75

Plus 20% tax where applicable

## DIODES

Cat No.	Desc.	10+	100+	1000+	100K+
Z10135	IN4148	0.03	0.02	0.015	0.013
Z10105	IN4002	0.04	0.03	0.03	0.025
Z10107	IN4004	0.05	0.04	0.03	0.025
Z10110	IN4007	0.10	0.06	0.05	0.04
Z10115	IN5404	0.18	0.14	0.09	0.08
Z10119	IN5408	0.20	0.16	0.10	0.09

Plus 20% tax where applicable

## LEDs 5mm STANDARD

	10+	100+	1000+
Red	\$0.10	\$0.09	\$0.08
Green	\$0.15	\$0.10	\$0.09
Yellow	\$0.15	\$0.10	\$0.09

Plus 20% tax where applicable

## MEMORY

"Check for the latest memory prices!"

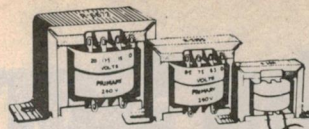
	10-99	100+	1000+	10K+
4164-15P	\$ 2.50	\$ 2.00	\$ 1.75	\$ 1.60
41256	\$ 6.00	\$ 5.00	\$ 4.50	\$ 4.00
6116P-3	\$ 3.00	\$ 2.90	\$ 2.20	\$ 2.00
2716	\$ 4.90	\$ 4.50	\$ 4.25	\$ 4.00
27128	\$ 5.00	\$ 4.50	\$ 4.00	\$ 3.50
2532	\$ 7.50	\$ 6.50	\$ 6.40	\$ 6.30
2732	\$ 6.50	\$ 6.10	\$ 5.90	\$ 5.50
27256	\$11.00	\$10.00	\$ 9.00	\$ 8.00
6264	\$ 5.50	\$ 5.00	\$ 4.50	\$ 4.00
2764	\$ 6.00	\$ 5.00	\$ 4.50	\$ 4.00

Plus 20% tax where applicable

## IC's GALORE!

	1-9	10+	100+	250+
8035	3.90	3.70	3.50	3.00
8085	4.00	3.90	3.50	3.00
8088	19.00	18.00	15.00	14.00
8155	3.90	3.75	3.50	3.00
8156	3.50	3.30	2.90	2.50
8212	1.90	1.70	1.50	1.00
8224	2.40	2.00	1.90	1.50
8226	1.90	1.70	1.50	1.00
8237A	35.00	31.00		
8253	3.90	3.70	3.50	3.00
8255	4.00	3.50	2.90	2.00
8257	3.90	3.50	3.00	2.50
8259	3.90	3.50	3.30	2.70
8237A	35.00	31.00		
8279	3.90	3.50	3.30	2.70

Plus 20% tax where applicable



## TRANSFORMERS

Cat No.	1-99	100+	1000+
M12851	2851	2.50	2.25
240V 12-6V CT 150mA			1.90
M12155	2155	4.80	4.10
240V 6-15V 1A tapped			3.70
M12156	2156	6.35	6.15
240V 6-15V 2A tapped			5.95
M16672	6672	6.35	6.15
240V 15-30V 1A tapped			5.95
M12860	2860	3.00	2.50
240V to 15V C.T. at 250mA			2.30

Plus 20% tax where applicable

## NEW TRANSFORMER!

	10-99	100+	250+
M12840	2840	3.00	2.50
240V to 9V C.T. at 150mA			2.30

Plus 20% tax where applicable

## RESISTORS

1/4 WATT E12 CARBON BULK  
PACKED \$5.25/1000  
TAPED AND BOXED \$5.25/1000  
\$5.00/1000 10K LOTS  
1/2 METAL FILM TAPED AND BOXED  
\$12.00/1000 \$11.00/1000 10K LOT  
SUPPLY E24 VALUE  
Plus 30% tax where applicable

## POLYESTER 100V "GREENCAP" TYPE

Cat No.	1-99	100+	1000+
R15131	.001uF	0.06	0.04
R15137	.0012uF	0.06	0.04
R15138	.0015uF	0.06	0.04
R15140	.0022uF	0.06	0.04
R15142	.0033uF	0.06	0.04
R15143	.0039uF	0.06	0.04
R15145	.0047uF	0.06	0.04
R15146	.0056uF	0.06	0.04
R15147	.0082uF	0.06	0.04
R15148	.01uF	0.07	0.05
R15150	.015uF	0.07	0.05
R15152	.022uF	0.07	0.05
R15154	.033uF	0.07	0.05
R15155	.039uF	0.07	0.05
R15156	.047uF	0.08	0.06
R15157	.056uF	0.08	0.06
R15158	.068uF	0.08	0.06
R15159	.082uF	0.08	0.07
R15160	.1uF	0.09	0.08
R15162	.15uF	0.11	0.10
R15164	.22uF	0.15	0.14
R15165	.27uF	0.16	0.15
R15172	.1uF	0.70	0.55
R15176	2.2u	1.20	1.10
R15178	3.3uF	1.50	1.20

Plus 30% tax where applicable

## NICADS

Cat No.	1-99	100+	250+	500+
S15020	AA	1.60	1.50	1.40
		1.40	1.10	

Plus 20% tax where applicable

**"Your prime source for quality electronic components and hardware at the lowest prices!"**

## LOW PROFILE IC SOCKETS

	10+	100+	1000+	10K
8 Pin	.08	.07	.06	.05
14 Pin	.10	.09	.08	.07
16 Pin	.11	.10	.09	.08
18 Pin	.12	.11	.10	.09
20 Pin	.13	.12	.11	.10
22 Pin	.14	.13	.12	.11
24 Pin	.15	.14	.13	.12
28 Pin	.19	.17	.15	.14
40 Pin	.25	.24	.22	.20

Plus 20% tax where applicable

## RG CAN TYPE WITH LUGS

	1-99	100+	250+
R164585	8000uF 75V	6.00	5.90
R16587	10,000uF	7.00	6.50

Plus 30% tax where applicable

## UNPROTECTED STRIP HEADERS

	1-9	10+
P12240	10 Way Unprot Header	1.25
P12246	16 Way Unprot Header	1.35
P12250	20 Way Unprot Header	1.45
P12256	26 Way Unprot Header	1.50
P12260	30 Way Unprot Header	1.75
P12264	34 Way Unprot Header	1.95
P12270	40 Way Unprot Header	2.25
P12275	50 Way Unprot Header	2.75
P12280	60 Way Unprot Header	2.95

Plus 20% Sales Tax where applicable

## R.A. HEADERS

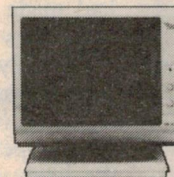
	1-9	10+
P12241	R.A. 10Way Unprot Head	1.45
P12247	R.A. 16Way Unprot Head	1.55
P12251	R.A. 20Way Unprot Head	1.65
P12257	R.A. 26Way Unprot Head	1.70
P12261	R.A. 30Way Unprot Head	1.95
P12265	R.A. 34Way Unprot Head	2.15
P12271	R.A. 40Way Unprot Head	2.45
P12276	R.A. 50Way Unprot Head	2.95
P12281	R.A. 60Way Unprot Head	3.15

Plus 20% Sales Tax where applicable

## COMPUTER CONNECTORS

Cat No.	Description	1-99	100+	1000+
P10900	DB25 Plug	1.30	1.20	1.00
P10901	DB25 Socket	1.40	1.30	1.20
P12210	Centronics Solder	3.50	3.15	2.50
P12200	Centronics Crimp	6.00	5.50	5.00
P10880	DB9 Plug	1.30	1.20	0.90
P10881	DB9 Socket	1.40	1.30	1.00
P10890	DB15 Plug	1.30	1.20	0.90
P10891	DB15 Socket	1.40	1.30	1.00
P10902	DB25 Cover	.80	.65	.55

Plus 20% tax where applicable



## RITRON II

Swivel base monitor in stylish case.

	1-9	10+	50+
Green Cat. X14506	\$145	\$135	\$115
Amber Cat. X14508	\$150	\$140	\$120

Plus 20% tax where applicable



## DATA CASSETTES

Check our low prices on these quality tapes!

	1-9	10-99	100+
\$0.75		\$0.70	\$0.65

Plus 20% tax where applicable

## PRINTER PAPER

60gsm 2000 Sheets 11 x 9 1/2"

	1-3	4-9	10+
	29.00	25.00	23.00

Plus 20% tax where applicable



## VERBATIM DATA LIFE DISKETTES

	10-99	100+	500+
5 1/4" SS/DD MD525-01	2.50	2.35	2.25
5 1/4" DS/DD MD550-01	3.20	2.50	2.40

## XIDEX DISKETTES

	10-99	100+	500+
5 1/4" SS/DD	2.50	2.50	2.25
5 1/4" DS/DD	3.40	3.05	2.85
3 1/2" SS/DD	5.90	4.75	
3 1/4" DS/DD	6.90	5.55	

Plus 20% tax where applicable



## ADD ON DISK DRIVE FOR 6502 SYSTEM (APPLE\* COMPATIBLE)

	1-9	10-24	25+
\$160		\$150	\$140

(\*Apple is a registered trademark)

## MITSUBISHI DISK DRIVES

	1-9	10+	25+
4851	5 1/4" 500K	\$195	\$185
4853	5 1/4" 1M	\$265	\$245
4854	5 1/4" 1.6M	\$295	\$260
2896	8" 1.6M	\$570	\$515

Plus 20% tax where applicable

## IBM ADD ON HARD DISK

	1-9	10+	25+
10 Mbyte			
Seagate hard disk			
Hard disk controller by Xebec			
Cat. X20010			\$1295

Plus 20% tax where applicable

# RITRONICS WHOLESAL

Incorporated in Victoria

Pty. Ltd.

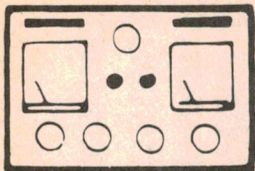
56 Renver Road, CLAYTON, 3168, VICTORIA, AUSTRALIA. Phone (03) 543 2166 (3 lines) Telex: AA151938

Minimum account order is \$50, minimum cash sale is \$25. Minimum post/pack \$3.00. Minimum account post/pack \$5.00. Comet Road Freight, bulky items and/or over 10Kg is extra.

Bankcard, Visa and Mastercard welcome

Errors and Omissions Excepted.





## The case of the mystery chassis

Once upon a time identifying who made a particular chassis was quite simple; AWA sets were made by AWA, HMV sets by HMV, Philips sets by Philips, and so on. But not these days. Many sets carrying well known brand names are now fitted with chassis made by quite different companies. And knowing who makes what to go in which cabinet is often quite important for the serviceman.

As you can imagine, that little homily was prompted by a recent experience which I am about to relate. But the story has another claim to fame. In past issues I have described intermittent faults of long standing, some of which have taken — literally — years to find. On one occasion I think I suggested that one of these must constitute some kind of record. And, while I can't remember the exact details, I have a feeling that this story will break that record, whatever it was.

But to get back to the "Who makes what" situation. My first encounter with this set was some four years ago and, at that time, I had yet to sort out all the ramifications I am about to relate. Had I known then what I know now I would have saved myself a significant amount of time and effort.

The set was owned by a lady whom I had not met before. She rang me and explained that she was having trouble with her colour TV set, adding that she had bought it a couple of years previously from a nearby dealer who, incidentally, has since gone out of business. She described the set as a General Electric model which the salesman had told her was made by Rank Arena and that, in fact, it was the same as the Rank Arena 2601. This didn't surprise me because I knew that a lot of GE sets at that time used a Rank chassis.

She went on to explain that the set had gone completely dead, but that it had given a lot of trouble in the past of an intermittent nature. Basically, the set would simply refuse to start at switch-on, but would usually come good at the second or third try, and might then run for several hours. At other times it would simply shut down spontaneously and would need several tries to get it

going again. Several servicemen had attempted to fix the trouble, but without success.

When I finally came face to face with the set in the lady's lounge room, I found it to be a GE model TC63L1; a type number which I had not heard of until then. But it was a 63cm model and I was quite prepared to encounter a Rank 2601 chassis.

It was a bit of a shock, therefore, when I looked into the back of the cabinet and realised that, not only was it nothing like a 2601 chassis, but that it was nothing like any chassis I had seen before. What was more, I could find nothing on the chassis to indicate who had made it. All I did determine was that it was made in Singapore.

The only thing to do in these circumstances was to contact the local GE distributors, first to identify the chassis and then, hopefully, obtain some clues as to the likely cause of the fault, assuming that someone else had already encountered it. In fact, the distributors proved to be most helpful, and set an example which some other distributors could well emulate.

### H stands for Hitachi

It turned out that the chassis was made by Hitachi and, more specifically, is almost identical with the Hitachi CWP-139 which I dealt with in the October 1985 notes. However, at that time the chassis was new to me. I also learned that the GE model number, on sets using the Hitachi chassis, normally carries a suffix letter "H" or "S", indicating where the chassis was made. The "H" indicates Hiroshima and the "S" Singapore.

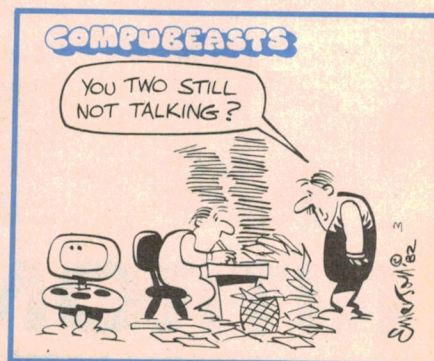
And, for what it is worth, all the larger chassis, i.e., 56 and 63cm, made

by Hitachi for the GE label are made in Singapore; only the smaller sizes are made in Japan. In fact, as far as I can determine, there are no 56 and 63cm sets marketed under the Hitachi label; they all carry the GE trademark. All of which adds up to a rather complex set-up, but it may be worthwhile keeping in mind.

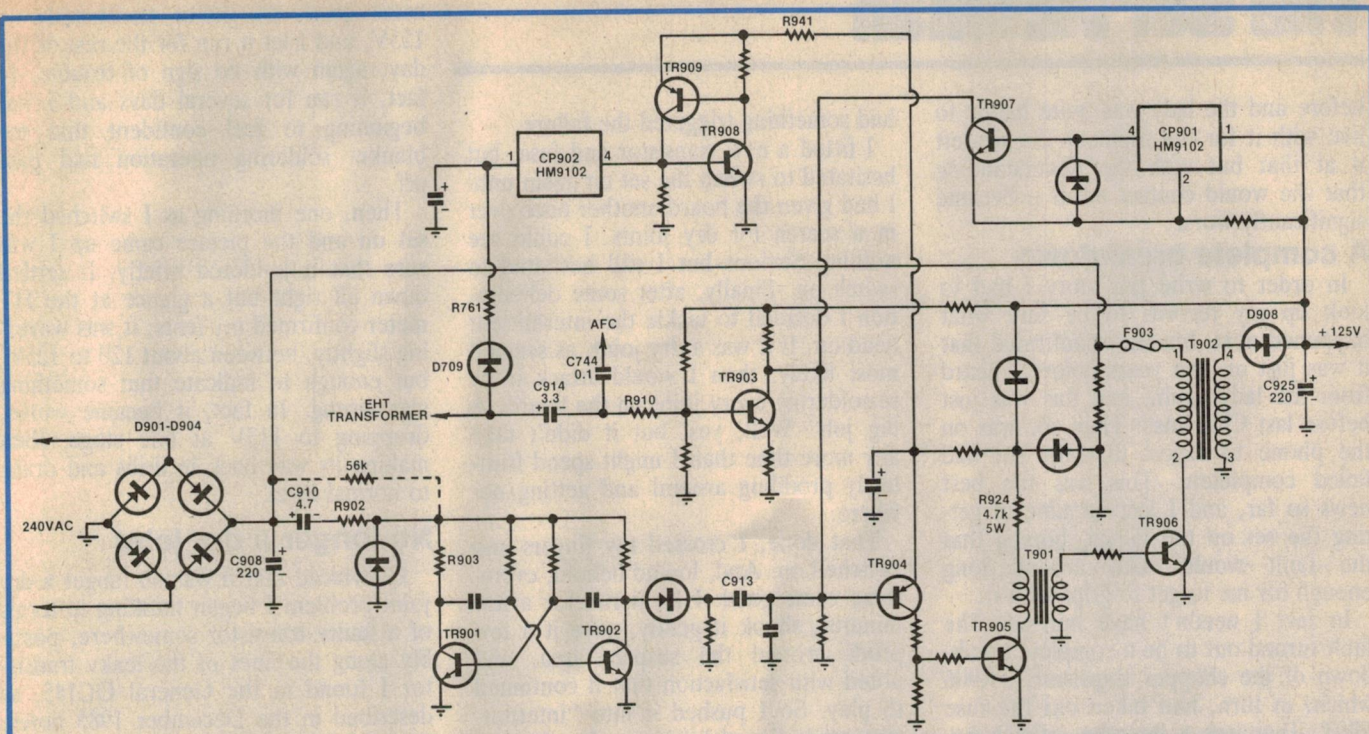
Having sorted out the origin of the beast I was able to obtain a circuit and service data and, with the set on the bench, make an initial appraisal of the fault, at least in general terms. As I more or less expected, it transpired that the power supply was shutting down — or refusing to start — although the exact reason had still to be determined. (At this stage readers may find it helpful to refer to the October story, particularly the explanation of the power supply operation and the manufacturer's suggested test routine.)

I went through these various tests, even though the intermittent nature of the fault made it unlikely that I would find it this way. In fact, all I learned was that one of the tests, that of running the power supply unloaded, was the surest way to destroy the main chopper transistor, TR906. So I was back to square one.

At this point I appealed directly to the GE service department. And, again, they proved most helpful. Further, from their ready response, it was fairly obvious that this was not an isolated case. More specifically, it was almost certainly a dry joint situation, the problem







This skeleton circuit of the GE-TC63L1 power supply is almost identical with the Hitachi CWP-139 circuit in the October 1985 notes.

being, of course, to find it. However, they were able to nominate a number of places where these were most likely to occur.

The first general area was on the power supply board itself and involved a number of heavy duty resistors which, in an effort to improve the dissipation, are mounted clear of the board by some 10mm. And, to improve the rigidity of the mounting over that provided by the pigtailed alone, they are supported by small metal tubes. These are a few millimetres in diameter and are passed through holes in the board and soldered to the copper pattern.

The pigtailed are then passed through the tubes and, I suspect, are supposed to be soldered direct to the copper pattern, so that the tube serves purely as a mechanical support. In practice the pigtailed are inserted in the tube, trimmed short on the copper side, and soldered to the inside of the tube.

Unfortunately, a good soldered joint of this kind is not easy to make, particularly with the heat limitations imposed by the printed board. As a result, they had proved to be a consistent source of trouble and the service department's advice was to remove each resistor and remake the joints thoroughly.

The second suspect area was on the deflection output board and, specifically, involved two resistors, R721 (390Ω) and R722 (4.7Ω), both in the base circuit of the horizontal drive transistor, TR704. Not only were these

particularly prone to having dry joints, but they also suffer the disadvantage of being almost completely hidden underneath a heatsink on which is mounted the horizontal output transistor, TR707.

I thanked the technician for his advice and, thus armed, returned to the attack. First I tackled the transistors on the power board, resoldering the pigtailed inside the tubes, using plenty of heat and a little mild flux to help things along. In fact, I found no evidence of any actual faults in this area, but reasoned that remaking them was a worthwhile precaution.

Unfortunately, this did nothing to improve the situation, the fault being just as much in evidence as before. So I removed the horizontal output stage heatsink assembly and checked R721 and 722. And this was a different story; anyone with half an eye could see the dry joints, though why these two resistors were prone to this fault so consistently remains a mystery. Anyway, I resoldered them, re-fitted the heatsink, and tried again.

And this time the set came good. I had given the lady a loan set so I took the precaution of running the set for about three weeks, during which time it didn't so much as flicker. I considered the point proved and returned the set, but took my usual precaution of advising the lady to contact me immediately if the trouble re-appeared.

I heard nothing more about the set for something like 18 months, by which

time I had more or less forgotten all about it. Then the lady was on the phone reporting that the set had once again developed an intermittent fault. So I organised another loan set and brought the offender back into the workshop.

This proved to be a totally frustrating exercise. I kept it for several weeks but nothing I could do during that time would induce the fault to appear. Finally, realising that Murphy had the whip hand, I returned the set to the customer, explained the situation, and suggested that she try to live with it until the fault became worse or, better still, the set failed completely.

### For richer for poorer . . .

The lady was quite happy with this arrangement because the fault, when it did show, was easily cured. She had found that all she had to do was switch the set off, then on again, and it invariably came good. So we left it at that and, although I had made out a docket when the set came in, I put it to one side and made no charge.

Apparently I didn't make this point clear to the lady and, after a couple of months, she rang to find out what she owed me. (I wish some of my other customer's were as honest!) I explained that I hadn't felt justified in charging in the circumstances, seeing that I had not really achieved anything, then asked her how the set was performing.

It appeared that it was still much as



# The Serviceman

before and the lady was quite happy to live with it for the moment. So we left it at that but with the understanding that she would contact me if it became significantly worse.

## A complete breakdown

In order to write this story I had to look up my records to be sure what happened next, but they confirmed that it was just on two years before I heard from the lady again, and this was just before last Christmas. Then she was on the phone to report that the set had failed completely. This was the best news so far, and I lost no time in getting the set on the bench, hoping that the fault would stick around long enough for me to get to grips with it.

In fact I needn't have hurried. The fault turned out to be a complete breakdown of the chopper transistor, TR906 which, in turn, had taken out the fuse F903. That was a bit of a setback because, whatever the intermittent fault was, it was certainly not what I had just found. There was also the important question as to just why TR906 had failed. Had it simply died of old age, or

had something triggered the failure.

I fitted a new transistor and fuse, but hesitated to switch the set on again until I had given the board another once over in a search for dry joints. I could see nothing obvious but I still hesitated to switch on. Finally, after some deliberation I decided to tackle the intermittent head on. If it was a dry joint, as seemed most likely, then I would attack it by re-soldering every joint on the board. A big job? Well, yes, but it didn't take any more time than I might spend fruitlessly prodding around and getting nowhere.

That done, I crossed my fingers and switched on. And, lo and behold, everything came good. I let it run for a few minutes, shook it gently, gave it a few prods around the suspect area, and noted with satisfaction that it continued to play. So I pushed it into "intermittent corner" and let it run for the rest of the day.

It survived this test and the next morning I connected a meter to the HT rail, which runs at 125V in this model, then turned it on again. Everything

came good, the meter sat steadily on 125V, and I let it run for the rest of the day, again with no sign of trouble. In fact, it ran for several days and I was beginning to feel confident that my blanket soldering operation had paid off.

Then, one morning as I switched the set on and the picture came up I was sure that it juddered briefly. It settled down all right but a glance at the HT meter confirmed my fears; it was wavering slightly, between about 120 to 125V, but enough to indicate that something was wrong. In fact, it became worse, dropping to 113V at one stage, then making its way back in dribs and drabs to normal level.

## No longer a dry joint

Convinced that it was no longer a dry joint problem I began thinking in terms of a faulty transistor somewhere, possibly along the lines of the leaky transistor I found in the General GC145, as described in the December 1985 notes. So I reached for the freezer can and attacked each transistor in turn. The result was totally negative; it made not the slightest difference.

So, if it wasn't thermal, was it mechanical; a hairline crack for example. I

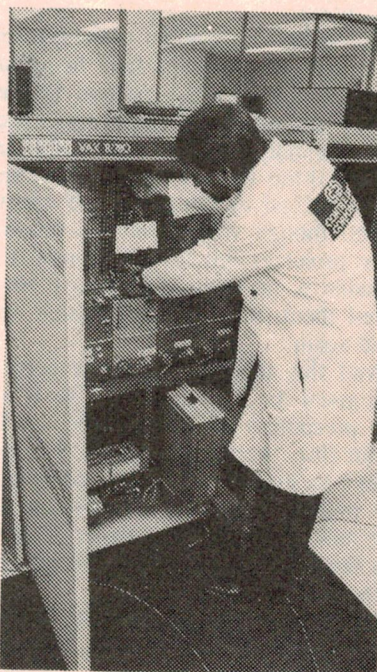
# If you're into computers you could have a job for life.

If you're interested in the finer points of digital electronics and computers, the computer industry needs you.

Enrol now into Control Data Institute's Computer Engineering course and you could be working in the ever-expanding computer industry in as little as 8 months.

Control Data Institute's flexible study programmes will allow you to study full-time or part-time in subjects such as **Electronics, Microprocessors, Mini Computers, Data Communication, Terminals, Disk Drives, Line Printers and Machine Language Programming.** Or if you choose, you can study individual subjects.

You can even get exemptions if you have some experience in the electronics field. And at the end of your



course of study, you qualify with a Diploma in Computer Engineering.

Control Data is accepting enrolments now for their Computer Engineering courses in Sydney and Melbourne. The demand for Control Data Engineering Graduates has never been higher.

For further information call Control Data Institute now. You can attend special monthly free engineering information seminars or phone Wendy Mason in Sydney on (02) 438 1300 or Sherrill Maconachie in Melbourne on (03) 268 9666 for a personal appointment.

**CD CONTROL DATA INSTITUTE**

**YOUR CAREER BEGINS HERE**

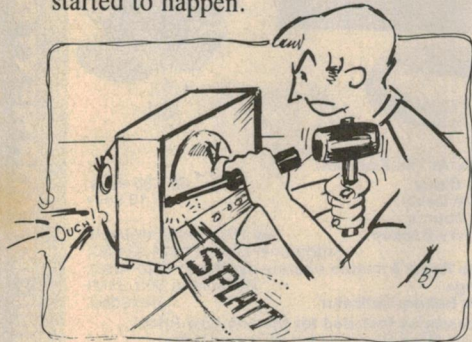
An education service of Control Data Australia Pty. Limited.

Burrows Doble Lawrence CDA 1640



left the set running and attacked the board with a substantially insulated prod, the sort of thing with which one can exert considerable pressure on a suspect component without fear of producing short circuits or shocks.

This didn't seem to achieve anything and finally, taking my courage in both hands — and putting one of them in my pocket — I very gingerly began wiggling the various heavy duty resistors between my fingers, while the set was running. Again I didn't seem to be getting anywhere, at least initially, but when I came to R924, a 4.7k $\Omega$ , 5W resistor feeding the collector of TR905, things started to happen.



**I exerted rather more pressure! F903 went out in a blaze of glory!**

The first wiggle produced no effect but at the second try, when I exerted rather more pressure, there was a sudden splat and fuse F903 went out in a blaze of glory. Nor was I surprised to find that the horizontal output transistor, TR906, had again been destroyed.

At this stage I wasn't quite sure what had happened except that the little support tube at one end of the resistor now appeared to be slightly loose, but I wasn't sure whether this was a real fault or one that I had created by being too heavy handed. On the other hand I was beginning to get some kind of a picture as to the possible cause of the original TR906 failure.

I pulled the board out and examined the print side in detail. I half expected to find that I had broken the copper pattern, but the real situation was quite different. As I have already mentioned I had been over the board and remade every joint, so it was something of a shock to discover that the solder adhering to the tube had broken away from the copper pattern. Yes, it was a dry joint, but one in which the solder had flowed out smoothly over the copper, giving every indication of a perfect joint.

Removing the solder from the tube uncovered the copper pattern to which the solder should have adhered, reveal-

ing the coating of black oxide. Just why this had happened is not clear, but it was obvious that the solder had never taken to the copper pattern or, if it had, in such a minute area that it eventually fractured and created a typical intermittent condition.

I carefully scraped away the oxide until I had bright copper, tinned it, then re-made the joint. I checked the joint at the other end by deliberately removing the solder, or as much as would come away, and satisfied myself that this one was OK. I checked all the assemblies in the same way and found two more joints in exactly the same condition.

I repaired these, fitted a new TR906, a new fuse, and put everything back together. The set came good when I switched it on, and continued without so much as a flicker for the next couple of weeks. Then, satisfied that I had really found the fault, I returned it to the customer. That was many weeks ago and a quick check as I finish off these notes confirms that it is still going with no sign of trouble.

I think I have really fixed it this time.

But why did the fault cause TR906 to fail? It seems virtually certain that the sudden open circuit in the supply rail to TR905, and the inductive load in this circuit (T901) generated a substantial spike as the magnetic field collapsed. This appeared in the secondary winding, was applied to the base of TR906, and the rest is history.

### With hindsight . . .

There are several lessons to be learned from this story. The first one, I'm sorry to say, is that your serviceman was not as adept at uncovering dry joints as he thought he was! With hindsight I was reminded of some advice proffered to me many years ago, by a

mate in the (then) PMG's telephone section. "The surest way to check a soldered joint is to try to remove the solder. If it is a good joint, you won't be able to."

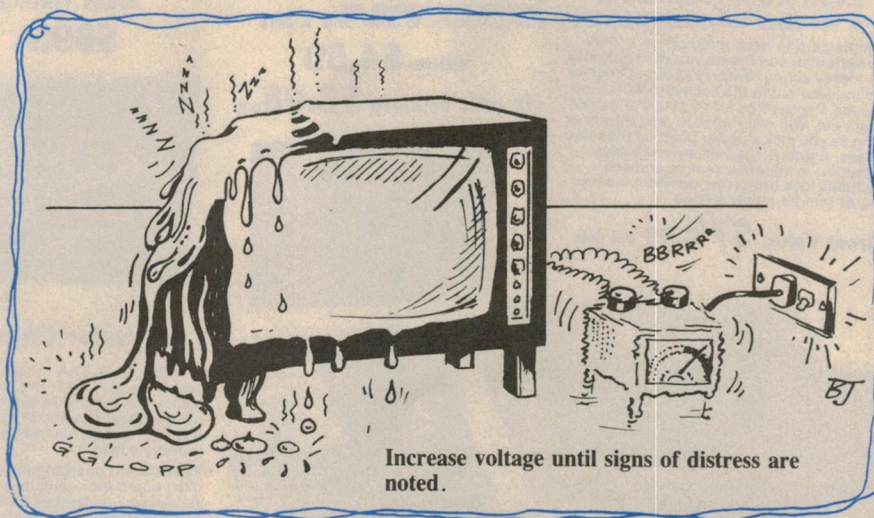
Sound advice indeed.

The other lessons are more general and simply amount to the fact that these particular chassis, under whatever brand name you find them, are prone to these dry joint problems. I earnestly suggest that my professional readers make a note of these faults and file them with the appropriate manuals. Also, it would seem to be a wise precaution if these sets, whenever they are encountered and for whatever other reason, are checked out thoroughly in these potentially troublesome areas.

And, finally, a further general comment about this type of power supply. In many cases where one suspects a likely flashover situation or other destructive fault, it is a wise precaution to power the set via a Variac, increasing the input voltage gradually until possible signs of distress were noted. But this is not possible with this circuit, which depends on the sudden application of voltage to C910 and its charging action to drive the multivibrator kick-start circuit and get the horizontal output stage working.

Fortunately, there are a couple of ways in which one can cheat. One is to fit the 56k $\Omega$  starting resistor, shown dotted in the circuit, which will drive the multivibrator section continuously. The other is to increase the voltage from the Variac in steps, the set being switched on in the normal way after each setting has been selected.

So there it is. One way and another I have managed to collect what I feel is a lot of valuable information about these sets. I hope others will benefit from it. **EA**





# COMPARE BEFORE

OUR PRICES

YOU BUY



Dear Customer, Over the last 9 years we at Altronics have toiled away often into the night with one major goal in mind — to provide you with competitively priced quality components and products with a superior standard of service. Looking back in 1986, I guess you could say the 10's of thousands of Shop and Mail Order Customers served, stand testament to our endeavours. We have resisted the "high powered advice" from Advertising firms to churn out expensive colour brochures and the like as eventually this must add to the cost of our products and unnecessarily waste your hard earned cash. (Even today of our products and Catalogues are produced "in house" at a fraction of the cost otherwise). The secret to our phenomenal growth we believe must lay, apart from our extremely conscientious attitude to service and delivery, in our policy of employing **Electronic Enthusiasts, Just like yourself**, in virtually every section of Altronics, so remember when you want a little technical advice — help is as close as your phone. Then of course there is the matter of our low prices!!

Jack O'Donnell

## Ultrasonic Insect and Pest Repeller

**Pestrepeller** is effective in controlling mice, rats, roaches, fleas, flies, crickets, silverfish waterbugs, moths, ants and most other common pests. Laboratory research has shown ultrasonic sound waves attack the auditory and nervous systems of most common pests causing them pain and discomfort. 130 decibels of sound waves are out of the range of hearing of humans and most household pets such as dogs, cats, fish and birds and farm animals. **Specifications - Dimensions:** 100 x 90 x 80 **Power Supply Adaptor** supplied 240/9V **Frequency Range** 30KHz to 65KHz variable **Output Level** 130db A 0083



**\$49.50**

## Why Risk Unnecessary Heart Attack?

Heart disease strikes down many people in their early 40's (or even 30's). The tragedy remains that had such victims been alerted, remedial medical, physical and dietary action could have been prescribed to avoid illness and in many cases restore full bodily health. X 3055

## Blood Pressure and Heart Rate Monitor

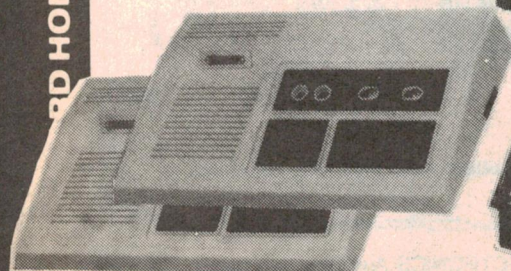
- Non-Microphone Measurement System
- LCD Readout
- Blood Pressure Monitor
- Pulse Rate Monitor

Don't Pay \$150 **\$89**

## Monitor the Baby's Room Even from Next Door FM Wireless Intercom System

Simply plug in each intercom to a 240V Power outlet and **Presto** you're in business no messy wiring to worry about — Great for calling Dad out in the backyard workshop, around Poolside or for monitoring babies room etc. Will even work to next door's as long as you pick a power point on the same phase. A and B channel switch allows selection to separate remote stations. Includes lock button for constant monitoring of remote point. A 0450

Great Value **\$79.95** per pair



## Microtek Microwave Detector \$19.95

High level leakage of hazardous radiation from the Microwave oven may occur due to damage or wear of sealing surfaces, the door, the door hinges or the door latches. Microtek is designed to detect the microwave leakage and to display the relative radiation strength on a level meter. Should the radiation reach a dangerous level, qualified personnel should be called upon for thorough checking and repair. It can detect radiation as low as 0.1 milliwatts per square centimeter. A 0900

## Just Arrived Mini Alarm

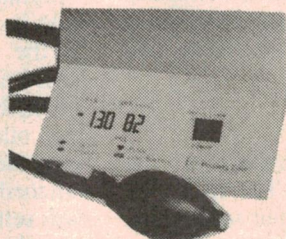
Fantastic for Door, Window or Cupboard — this great little alarm simply fixes to one surface (usually fixed surface) with the reed switch magnet screwed to the moving door, window sash etc. **Arm the system by simply switching on** — battery drain is minuscule! When door/window is opened **bingo** the surprisingly piercing alarm is operated. Sound Pressure level is 90db at 1ft. (300mm).

At our direct import price you can afford to fit several through the house for security of your possessions and "peace of mind" for all the family.

Operates from 9V battery (not supplied) (Alkaline type recommended for long service life).

Literally dozens of uses e.g. on the swimming pool gate when used with a weather protective shroud. S 5315

Value Plus **\$14.95**

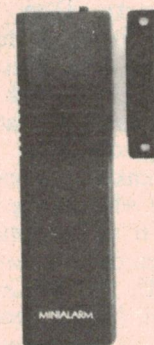
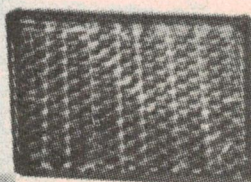


## Solar Cell Module .4V at 450mA

Great experimenters Solar Module. Connect in parallel or series as you wish. Terminal strap enables easy interconnection to other cells. A 0210

Value **\$4.50**

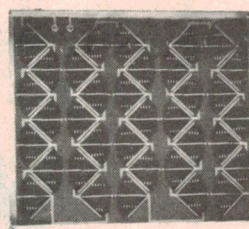
10 cells or more **\$3.98ea**



## Price Break Through Solar Cell Array 18V @ 7 Watt

Brilliant New Solar Array at an amazing price. Yes, for less than \$90 we now have just the handiest Solar Modules available (Why pay our competitors \$239 for a measly 3 additional watts?? Superb for Powering or Charging 12 - 15 Volt circuits — Now there's now excuse for that flat Car, Boat or Caravan Battery. Solar Cells are fixed to a fibre board, front covered with tough EPS and rivetted into stainless steel frame. Cat No. A 0220

Amazing Price Break Through **\$89.95**



## Solar Charger

Charges up to 4AA Nicads by simply placing in sun light. (we recommend placing on the inside window ledge in the extreme heat of summer). Will charge from dead flat to fully charged in 8-10 hours average sunlight.

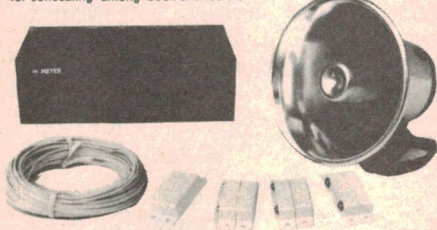
**Take Care** if charging inside car e.g. on dash board etc. — ensure car inside is well ventilated — remember midsummer inside car temperatures can be extreme. A 0230

**\$12.50**

## Protect Your Home for Just \$99 New Ultra Sonic Home/Office Alarm System

Fantastic system for this price. Frankly we were amazed at the performance of this very compact system.

Very simple to connect and operate — New Technology has enabled very compact overall dimensions (master unit only 180 x 100 x 65) hence ideal for concealing among book shelves etc.



## Look At The Features:

- Exit Delay 30 - 35 secs.
- Entry Delay 10 secs
- DC Source
- Battery Backup 9V Nicad rechargeable (additional Cost S 5024 \$14.50)
- Auto Reset 3 minute operate cycle and auto reset. Reliable to 30ft. (9M) Included.
- Range
- Low Battery Indicator

## Accessories Included for the one Low Price

- 4 Sets Reed Switches for Window/Doors
- 1 Roll fig "8" cable
- 1 External Type Horn Speaker
- 1 AC/DC plug pack adaptor

Now there is no excuse for not Protecting yourself, your family and all your hard earned possessions!

S 5310 Only **\$99.00**

Out performs our main competitors system which, incidentally sells at around \$50 more for the comparable system and accessories.

## Up to Incredible 1KM Range Professional Megaphone PA 20 Watts Max. Power with In-Built Whistle

A new product for 1986, our A 1990 Megaphone PA is quite simply one of the finest around irrespective of price. This is an extremely sturdy unit with a quality in-built 20 watt (max) low distortion amplifier. Another secret of the fine performance is the incorporation of a noise cancelling microphone — the result is a surprising level of gain available without feedback even when used indoors in relatively confined spaces.

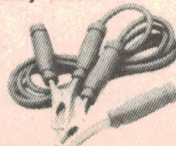
Why Pay \$150 or more?



**\$99.95**

## 100 Amp Jumper Leads Superb Quality

These are the real McCoy. Extra heavy duty 100 Amp capacity. Get a set for your car today. A 3011



**\$17.50**



BANKCARD HOLDERS — PHONE ALTRONICS TOLL FREE 008 999 007 FOR NEXT DAY JETSERVICE DELIVERY

## Infra Red Movement Detector

**With interchangeable lens for corridor or wide angle detection**

The Infra Red or IR detector for short is basically a high gain passive tuned receiver of a particular IR band. The heart of the unit consists of a high gain lens (antenna) which has a "Commutated" field of view. Its reception pattern is comb-like, but highly tuned to the IR wavelength of human bodies. When a human passes within proximity of the pickup area, the lens will selectively pick up IR radiation and then not. Movement across the pickup area will result in a series of pulses sent to a detector circuit. IR detectors are very reliable as they do not transmit and will not respond to non heat radiating objects.

### Features:

- Lens simply 'snaps' to either wide angle (range 40 feet) for normal use or Normal angle (range 80 feet plus) for corridor applications.
- Snazzy integral mounting bracket allows corner 90 deg. mounting as well as normal surface mount. (This is a fantastic feature as these work best in corners and are visually unobtrusive)
- 12V DC Powered
- Built-in test lamp
- Alarm output SPDT 30V 1A

S 5301

**\$89**

## New Generation Calculators

**Direct from the Importer**

Our COMPLEX Printing/Display Calculator is just the shot for the office. The feel and response of the keys is both light and positive, an essential characteristic in our view. More than favourably compares with others costing \$50 or \$60 more.

- 10 Digit LCD printing calculator • 9 entry key buffer memory • Adding machine calculation • Chain and mixed calculation • Full memory calculation • Round-off/down calculation • Percent key with add on discount calculations • Use normal paper (57.5mm width) • Size: 193 x 172 x 35mm • Weight: 480g. X 1060

Uses 4 x AA Batteries or Altronics Adaptor M 9001 \$9.95 Additional.

**Superb Printer/Display Calculator for the Office**

**NEW**



X 1070

**\$59**

Amazing Price

## Desk Mounted Lamp Magnifier



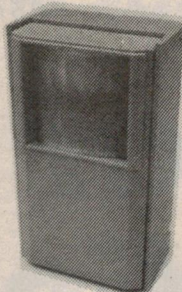
Only  
**\$169**

If you have trouble with fine PCB work or component identification but still want both hands free, this is for you. We thoroughly recommend this quality Australian made product.

**TECHNICAL INFORMATION Illumination:** 22W Fluorescent Weight: 8.16kg Lateral Extension: 254mm Vertical Extension: 254mm Fixing: Heavy table base (grey & Ivory) with two chrome plated flexible arms. Cat A 0980

## Piezo Ceramic Speakers

Piezo Ceramic Speakers offer several advantages over conventional speakers, as • No bulky magnet structure • no voice coil • No crossover network required • excellent transient response • Extremely low distortion • High impedance-as Piezo appears as capacitive rather than inductive load • Light weight • High power capability • All speakers are capable of handling in excess of 150 watts and can be configured to handle much, much higher.



## Data Tape

The criteria for data tape is of course, very exacting with many computers available today. Our D 1141 data tape is in our humble opinion one of the finest available today — anywhere! O.E.M. customers, Mytek Computing is reporting 96% success rate with High Speed Data Dubbing. This is of course quite phenomenal when one considers the dubbing speed is 30 times normal. D 1141

1—9	10—99	100 Up
<b>1.74</b>	<b>1.45</b>	<b>1.25</b>

## Round Tweeter

95.3mm Diam. Piezo Speaker Suitable for HiFi applications. Frequency Response: 3K to 40KHz Sensitivity: 104db @ 2.8V C 6100

**\$6.95**

4 Up **\$15**

## Motorola KSN 1025A

177.8 x 82.6mm Rectangular Piezo Horn Speaker suitable for HiFi and Sound Reinforcement. Full 90° Dispersion Angle • Freq.Res: 1.9 to 40KHz • Sens: 100db @ 2.8V C 6140

**\$29.95**

4 Up **\$28**

## Rectangular HIFI-PA Piezo

144.8 x 54mm Rectangular Piezo Horn Speaker suitable for HiFi and Sound Reinforcement. Full 90° horizontal dispersion angle • Freq.Res: 3 to 40KHz • Sens: 110db @ 2.8V C 6120

**\$18.95**

4 Up **\$17**



## RS-232 Surge Protector

The RS-232 surge protector is used to protect RS-232 ports from the possibility of costly damage from large voltage peaks caused by lightning or other power problems. The surge protector used Metal-Oxide Varistors (MOV) to protect pins 2,3 and 7. It has one male and one female connector with all 25 pins connected straight through and with MOV's connected between pins 1 and 2, pins 1 and 7. The MOV's will suppress any voltage above 26 volts without affecting the normal RS-232 voltage levels. The MOV's are capable of handling one joule of energy and 250 amps peak current. D 1510

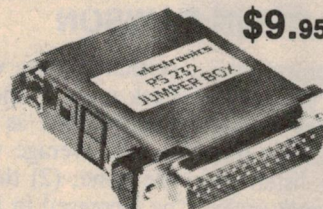
**\$19.50**



## RS-232 Jumper Box

The RS-232 Jumper Box is used to make custom RS-232 interfaces. It consists of a small board with a connector on each end. All 25 pins of each connector go to the 25 solder pads. By custom wiring these pads, many different interfaces can be built: null modems, pin reversers, etc. Also a cable can be connected to tap signals from the RS-232 line. D 1520

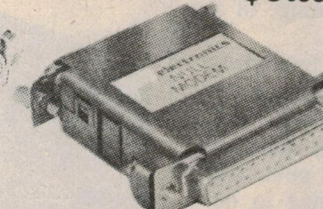
**\$9.95**



## Null Modem

The RS-232 Null Modem is used to replace a set 25-pin RS-232 connectors with transit DATA and receive DATA CROSS CONNECTED. (Pin 2 of each connector goes to pin 3 of the other connector). Pins 1 and 7 are connected straight through. Each connector is set up in the loop back mode with pins 4 and 5 shorted together and pins 6,8 and 20 shorted together. The RS-232 Null Modem is used when the proper operation of a set of modems is in doubt. It also is handy when Transmit DATA and Receive DATA need to be reversed. D 1530

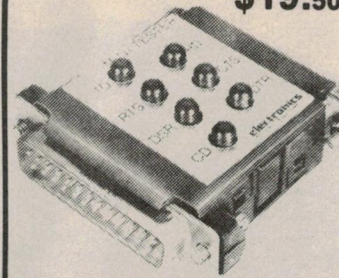
**\$9.95**



## RS-232 Mini Tester

This Tester indicates the presence of all important interface lines by LED illumination when signal is active. All 25 pins are connected straight through. D 1500

**\$19.50**



## Silky Quiet 240V Computer Fans

Sealed Sleeve Bearings for long Life • Sturdy die cast frame • Operating range-10 deg C to +70 deg C.

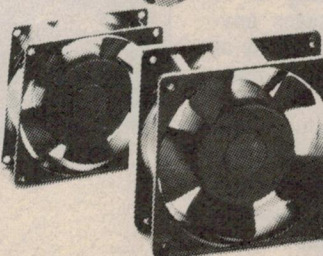
### Two Models

F 1020	80mm	<b>\$19.50</b>
F 1030	110mm	<b>\$19.50</b>



## Fan Finger Guards

F 1022 (for 80mm Fan)	<b>\$1.50</b>
F 1032 (for 110mm Fan)	<b>\$1.50</b>



## High Definition Computer Monitor New Micron Series 3

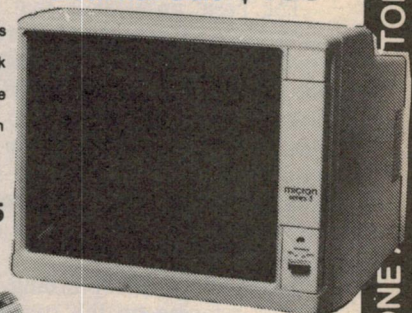
There are a number of low cost 'Hobbyist' monitors around these days at prices unheard of a year or so ago. However, they all suffer from poor to medium definition or resolution—hence eye strain becomes a real headache. The situation has all changed with the release of the superb Micron Series 3. Non glare, naturally, and screen character resolution well worthy of mating up with top end personal or professional computers.

- 1050 lines resolution at centre screen • 22 MHz band width • Video input impedance switch allows networking use.

### Specifications:

**Screen**—Green phosphor Front Controls—Power On/Off, character brightness/intensity, display centering **Rear Controls**—Background intensity, vertical and horizontal adjustment etc. **Input Impedance Switch** 75/10K **Bandwidth**—10Hz-22MHz **Resolution**—1050 lines minimum at centre screen. D 1115

**Green Non Glare \$199**

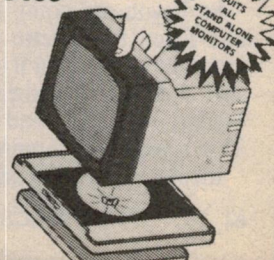


## Universal Monitor Stand With Pan & Tilt Adjustment

This brilliant monitor stand enables you to swivel left/right and tilt up/down i.e. to position monitor to any desired position. Hence viewing position is enhanced and screen glare eliminated. D 1100

**Altronics Direct Import Price is Now Under \$30**

**\$29.95**



BANKCARD HOLDERS — PHONE ALTRONICS TOLL FREE 008 999 007 FOR NEXT DAY JETSERVICE DELIVERY



**Listen to your favourite CDs on tape**

# Compressor for compact discs

*Ever tried to record a compact disc on a conventional cassette recorder? Unless your deck has dbx, you're not in the race. Even those machines with automatic level control cannot cope with the wide dynamic range of compact discs. That's where our CD Compressor comes in.*

**by COLIN DAWSON**

We've designed this Compressor to meet a number of different purposes. For example, you may love your collection of 'Dire Straits' compact discs but what happens if you want to listen to the same tracks on your Walkman-style cassette player when you go for a run? Or what about playing tapes in your car?

The basic problem is that a cassette deck cannot successfully record the wide dynamic range of a typical compact disc. Even if it has Dolby B noise reduction, it will not be able to cope. If it has Dolby C noise reduction it will be somewhat better but only a deck with dbx noise reduction will come close to coping with the full dynamic range of a CD.

That's okay for recording but when you're listening on the run or in a car barrelling down the expressway, you don't want high dynamic range anyway. You need a lot less. If you're pounding the pavement, you're not going to be interested in pianissimo passages anyway. And the average car is so noisy at speed that it drowns out the soft parts of the music.

So if you are going to usefully record and listen to cassette tapes made from compact discs, you'll want a compressor; a circuit to make the soft passages louder and the loud passages softer. That's what our compressor does.

Ideally, the compressor would operate

so that: (1) the volume control for playback is set to the same level for a compressed tape as an uncompressed one, ie, the average volume would be about the same; (2) the quiet passages should be increased in level, sufficient to overcome typical car background noise; and (3) the loudest passages should be reduced in level so that they do not cause distortion or discomfort to the listener

in a car.

Our design meets these objectives successfully while keeping distortion to low levels, with a relatively simple, low-cost circuit. Naturally, there is some compromise which mainly applies to very low level signals.

Some classical passages have sections so quiet that they are barely audible, even in an ideal listening environment. Amplifying these sufficiently to overcome the noise of your turbo-charged hories under the bonnet is not practical. Therefore, our design has a maximum gain of +9.2dB for small signals (a voltage gain of about 3).

For the loudest passages, the circuit has a maximum signal attenuation of -14.5dB (a voltage loss of about 5.3). This should take the sting out of the really loud sections.

Overall, the circuit reduces the dynamic range of the music by 9.2 +

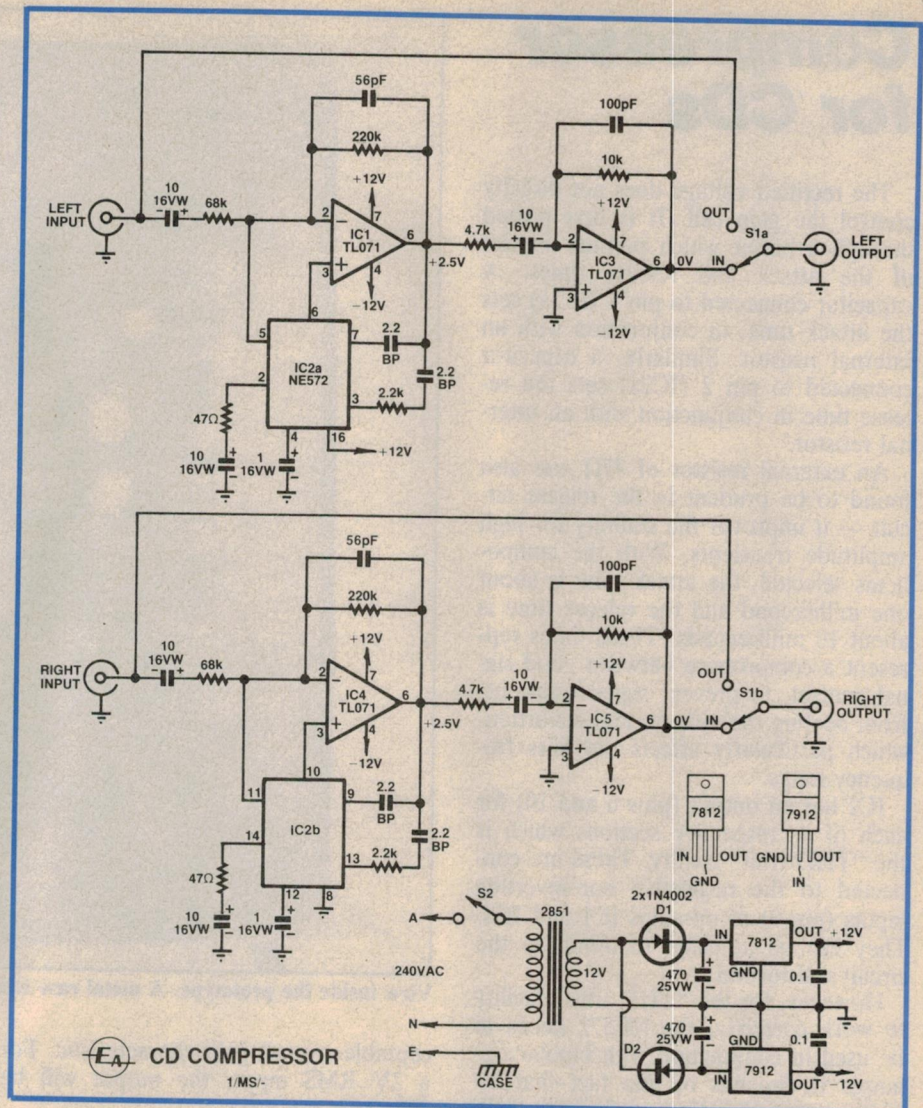


The input and output RCA sockets are mounted on the front panel of the metal case.

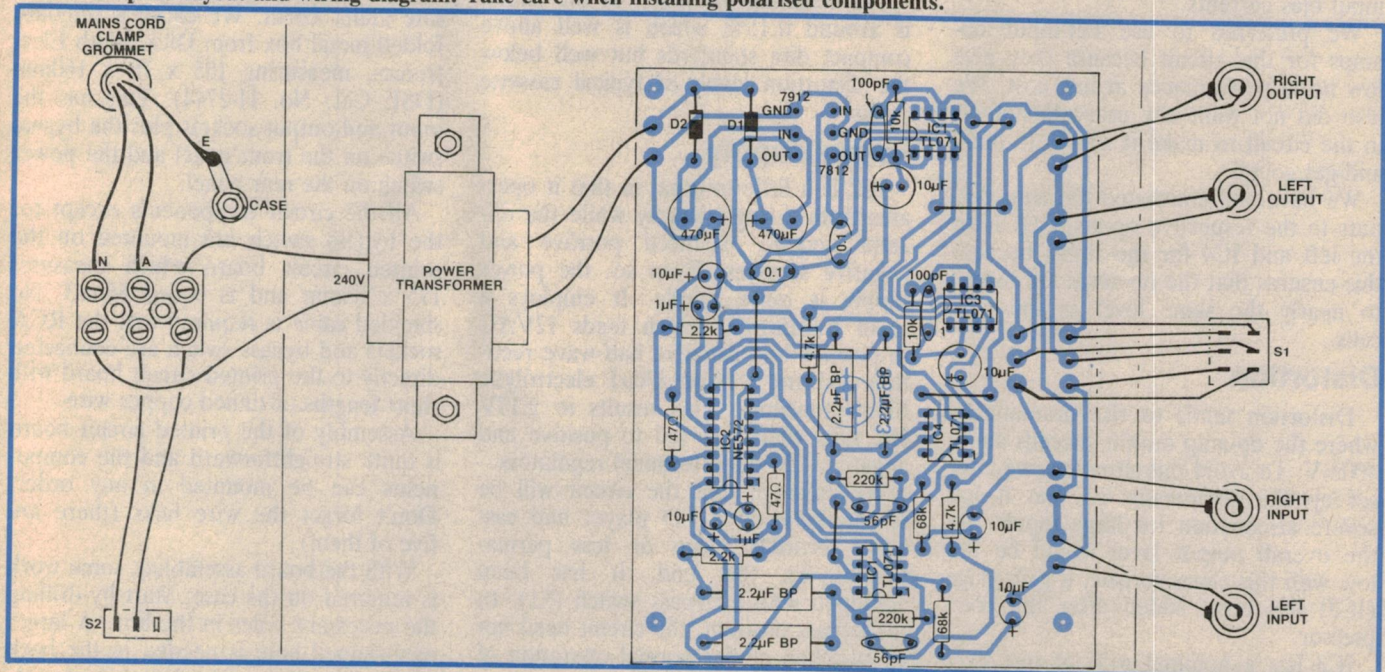


### Circuit Description

The control voltage is derived directly from the op-amp output signal. The output signal is fed into a rectifier inside the compandor chip (pin 3 for the left channel — we shall refer only to the left channel for most of the circuit description). The resultant voltage varies in proportion to the output signal amplitude.



**Below: the parts layout and wiring diagram. Take care when installing polarised components.**





# Compressor for CDs

The rectified voltage does not directly control the gain cell. It is first passed through a buffer which permits control of the attack and release times. A capacitor connected to pin 4 (IC2a) sets the attack time, in conjunction with an internal resistor. Similarly, a capacitor connected to pin 2 (IC2a) sets the release time in conjunction with an internal resistor.

An external resistor of  $47\Omega$  was also found to be prudent in the release circuit — it improves the stability for high amplitude transients. With the components selected, the attack time is about one millisecond and the release time is about 10 milliseconds. These times represent a compromise between good signal control, to prevent signal transients from beating the system, and distortion, which particularly affects the bass frequency range.

IC2 has an output (pins 6 and 10) for each of its respective sections which is the "THD trim" facility. These are connected to the respective non-inverting inputs (pin 3) of op-amps IC1 and IC4. They can be adjusted to minimize the circuit's distortion.

However, for the "THD trim" facility to work correctly, the NE572 needs to be used in conjunction with bipolar op-amps. It depends on the fact that bipolar op-amps draw relatively high input bias currents.

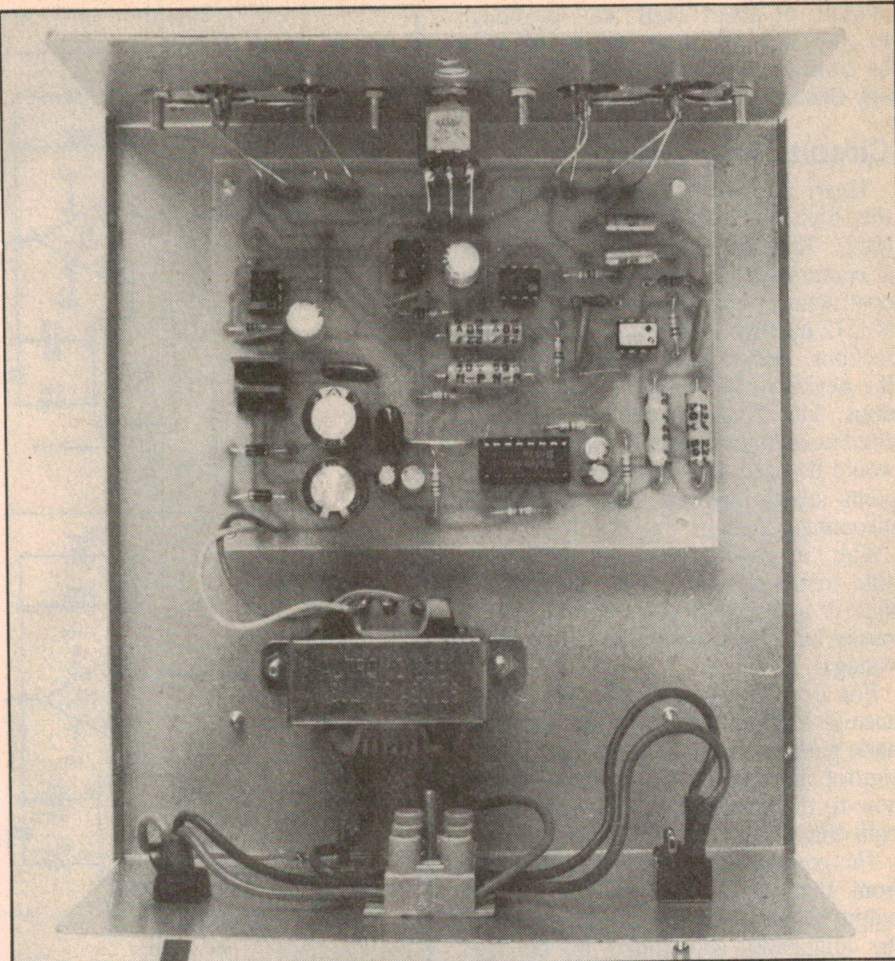
We preferred to use Fet-input op-amps for this circuit because they give low noise performance at low cost. We also did not want any user-adjustments in the circuit to make it simple to build and get going.

We have still connected the trim outputs to the respective op-amps (IC1 for the left and IC4 for the right) because this ensures that the op-amps are biased to nearly the same level as the gain cells.

## Distortion

Distortion tends to rise dramatically where the op-amp output exceeds about 400mV. To avoid this situation, we have set up the compressor so that it has severe attenuation for large inputs. As the overall output level would be too low with this characteristic, a gain stage (IC3) has been added after the compressor.

IC3 has a nominal gain of just over two, to provide the circuit with an ac-



View inside the prototype. A metal case is necessary to provide adequate shielding.

ceptable overall gain characteristic. For a 2V RMS input, the output will be 370mV.

The resulting distortion of the circuit is around 0.15% which is well above compact disc standards but well below the distortion levels of typical cassette decks.

## Power supply

IC2 is a little unusual in that it operates from a single supply while the op-amps require balanced positive and negative supplies. Even so, the power supply is quite simple. It employs a small transformer which feeds 12VAC to positive and negative half-wave rectifiers D1 and D2 and  $470\mu\text{F}$  electrolytic filter capacitors. This results in  $\pm 17\text{V}$  DC rails which are fed to positive and negative 12V three-terminal regulators.

We envisage that the circuit will be set up between a CD player and cassette recorder more or less permanently. To this end, it has been equipped with a bypass switch (S1). In the bypass position, the circuit need not be switched on for normal operation of the associated equipment.

## Construction

The circuit must be built into a metal box to provide good shielding and a safe mains earth. We chose a standard folded metal box from Dick Smith Electronics, measuring 185 x 70 x 160mm (DSE Cat. No. H-2744). This has the input and output sockets plus the bypass switch on the front panel and the power switch on the rear panel.

All the circuit components except for the bypass switch are mounted on the printed circuit board which measures 115 x 88mm and is coded 86ms3. No shielded cable is required and the RCA sockets and bypass switch are connected directly to the printed circuit board with short lengths of tinned copper wire.

Assembly of the printed circuit board is quite straightforward and the components can be mounted in any order. Don't forget the wire links (there are five of them).

With the board assembled, some work is required on the case. Start by drilling the necessary holes in the box. A large, oval-shaped hole is needed in the back panel for the cord clamp grommet,



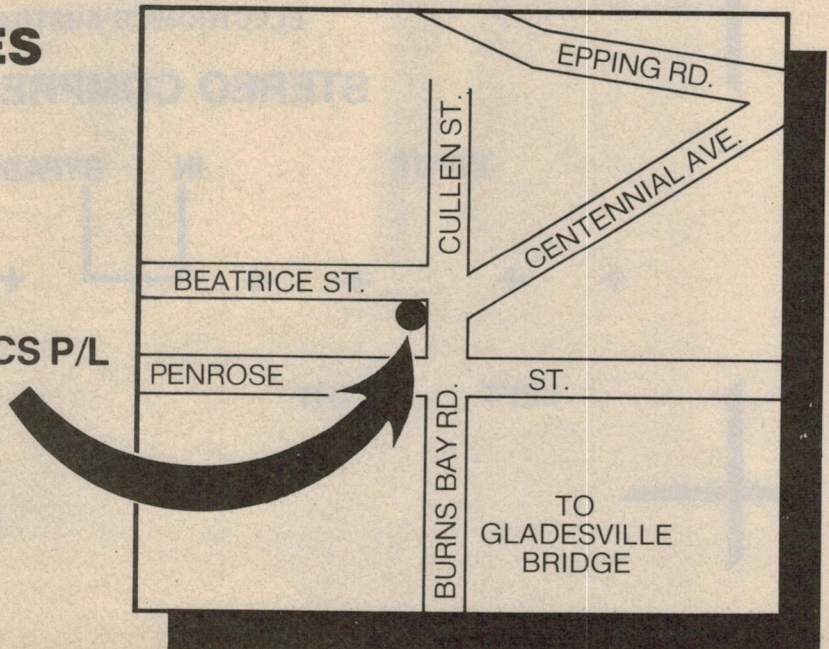
# GEOFF'S MOVED!



- **LARGER PREMISES**
- **BIGGER STOCKS**
- **EVEN BETTER SERVICE**

GEOFF WOOD ELECTRONICS P/L  
229 BURNS BAY ROAD  
LANE COVE 2066  
TEL:

**427 1676**





## Compressor for CDs

along with one for the power switch (S2), two for the terminal block and one for the earthing point.

Other holes which must be drilled are: two for the transformer mounting screws (in the base, towards the rear of the box); four for the PCB mounting screws — keep the PCB towards the front of the box; one on the front panel for the bypass switch (S1) and four others for the two-way RCA sockets.

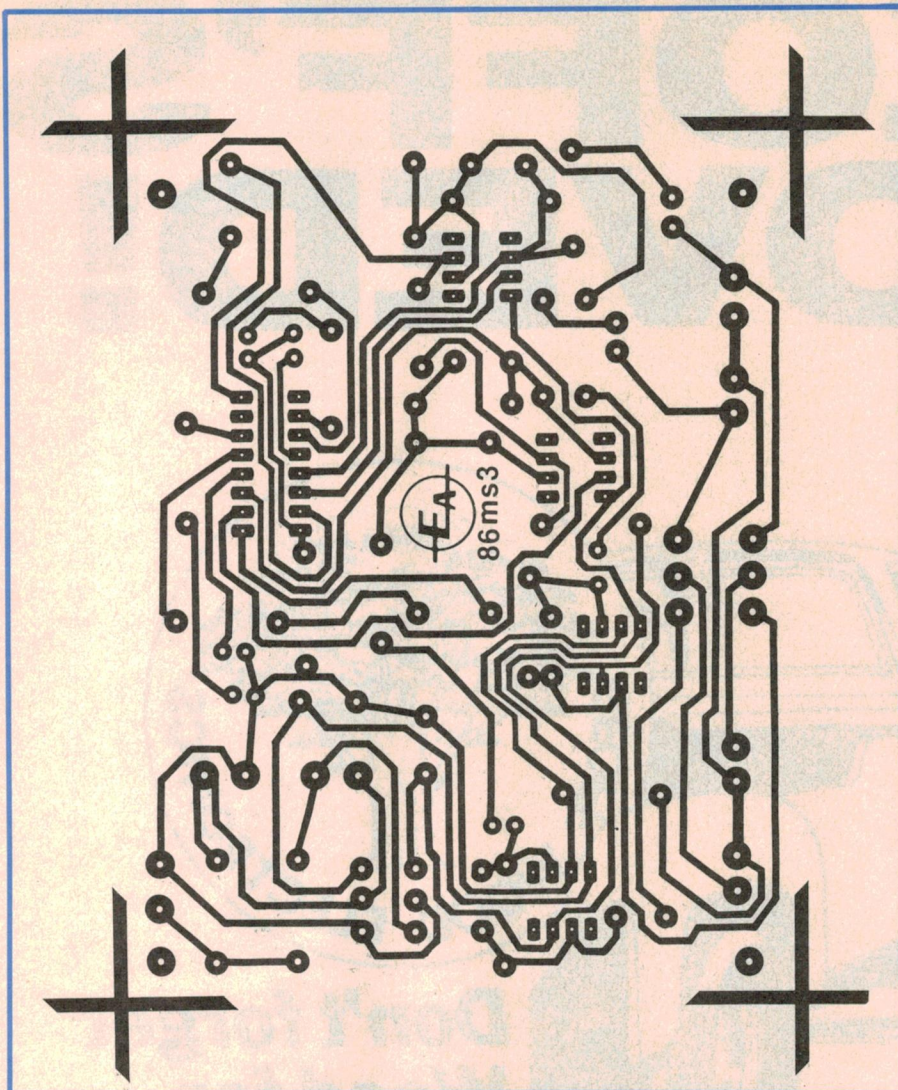
We opted to use a pair of two way RCA sockets on the front panel. The single type aren't really suitable as they are difficult to isolate from the front panel.

### Power on

When all assembly work is complete, check all your work thoroughly against the wiring diagram. With your multi-meter switched to a low "ohms" range, check that the earth pin of the power plug is connected to the chassis. Check also that both the active and neutral wires of the power cord are isolated from the rest of the circuit and chassis.

Now give the circuit a power up test without anything else connected to it — just in case. Assuming there are no sparks, smoke or other disturbing phe-

At left is an actual size artwork for the PCB while below is the front panel artwork.



ELECTRONICS AUSTRALIA

## STEREO COMPRESSOR

INPUT

IN

BYPASS

OUTPUT

+ + + + + + + +

LEFT

RIGHT

LEFT

RIGHT



nomena, check the voltages listed on the circuit diagram. Pin 6 of IC3 and IC5 should be within a few millivolts of 0V.

Now connect your CD player to the inputs of the compressor and your cassette deck to the compressor outputs.

The CD player to cassette recorder set up should work irrespective of whether the compressor is turned on or not, provided that it is switched to bypass.

Next, with the circuit powered up, switch the circuit in. If it's working OK, the loud passages should be reduced in volume, compared to when the bypass function is selected, and quiet passages should be louder.

If there is no sign of signal compression, an incorrectly installed electrolytic would be a likely cause.

EA

## PARTS LIST

- 1 metal box, 185 x 160 x 70mm, DSE Cat. No. H2744 or equivalent
- 1 12V transformer, Ferguson PF2851 or equivalent
- 1 printed circuit board, code 86ms3, 115 x 88mm
- 1 3-core mains cord and moulded plug assembly
- 1 3-way mains terminal block
- 1 single pole, single throw (SPST) mains switch
- 1 double pole, double throw (DPDT) switch
- 2 2-way RCA panel mounting socket strips
- 2 1cm pieces of heatshrink or spaghetti tubing (for mains terminals on transformer)
- 1 metre of tinned copper wire
- 4 5mm PCB stand offs

## Semiconductors

- 1 NE572 stereo compandor IC
- 4 TL071, LM351 FET input op-amps
- 2 1N4001 diodes
- 1 7912 -12V regulator
- 1 7812 +12V regulator

## Capacitors

- 2 470 $\mu$ F 25VW PC electrolytics
- 4 10 $\mu$ F 16VW non-polarised axial electrolytics
- 6 10 $\mu$ F 16VW PC electrolytics
- 2 1 $\mu$ F 16VW electrolytics
- 2 0.1 $\mu$ F greencaps
- 2 100pF ceramics
- 2 56pF ceramics

## Resistors (1/4W, 5%)

- 2 x 220k $\Omega$ , 2 x 68k $\Omega$ , 2 x 10k $\Omega$ ,
- 2 x 4.7k $\Omega$ , 2 x 2.2k $\Omega$ , 2 x 47 $\Omega$ .

# INTERESTED IN ELECTRONICS? THEN WHY NOT TURN YOUR HOBBY INTO A CAREER?



Alan Mulraney, Stott's Graduate, in his workshop.

In this fast-changing electronic world people with interest and **training** are going to be in demand. Turn your interest into a lucrative career in any one of the following fields:

**Computers • Industrial Controls • Medicine  
Radio Communications • Domestic Radio & Television**

Electronics plays an important role in these and many other fields. With a Stott's Home Study Course, training is easy, and will prepare you for a career in the manufacture, installation, commissioning, sales or servicing of electronic equipment.

You'll have experienced, professional instructors who will guide you through an integrated theory/practical program. They'll give you individual attention and advice, and prompt replies to all test assignments and queries. And best of all, you'll study at your own pace, in your own home.

Send the coupon today. It may be the smartest move of your life.

## Stotts

CORRESPONDENCE COLLEGE

The name to trust in correspondence education.

Please send me free, and without obligation, full details of the following courses:

\_\_\_\_\_ (PLEASE PRINT)

MR. MRS. MISS \_\_\_\_\_ AGE \_\_\_\_\_

ADDRESS \_\_\_\_\_

\_\_\_\_\_ POSTCODE \_\_\_\_\_

Stott's undertake that no sales counsellor will visit you.

**The Stott's range of courses in Electronics is:**

- Intro to Electronics
- Digital Electronics for Technicians/Servicemen
- Microprocessors
- Radio Receivers
- Radio/TV Servicing
- Colour Television

Melbourne, 140 Flinders Street, 3000. Tel: 63 6212

Sydney, 383 George Street, 2000. Tel: 29 2445

Brisbane, 65 Mary Street, 4000. Tel: 221 3972

Adelaide, 226 Pulteney Street, 5000. Tel: 223 3700

W. Perth, 25 Richardson Street, 6005. Tel: 322 5481

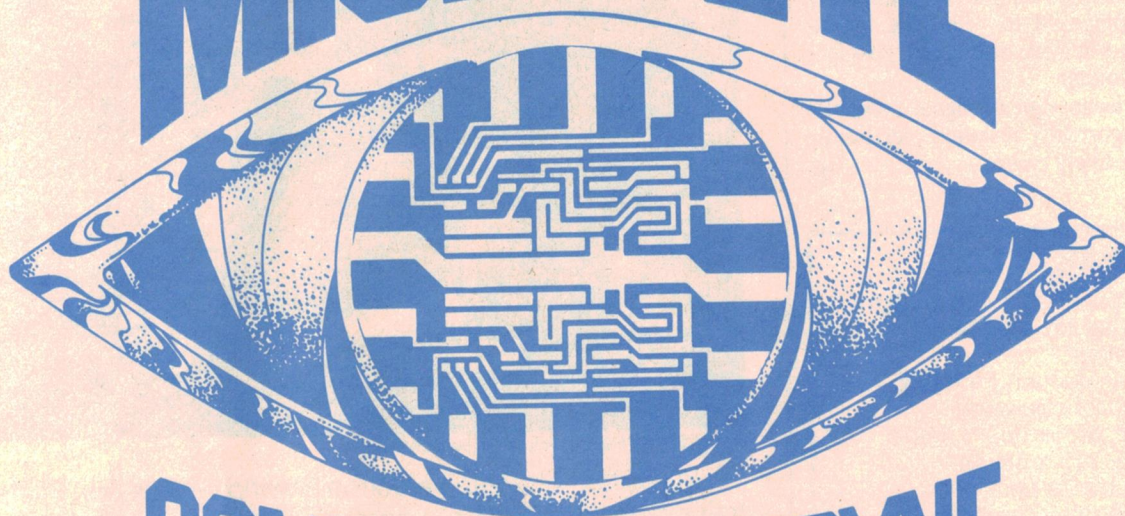
Hobart, 150 Collins Street, 7000. Tel: 34 2399

New Zealand, Box No. 30-990, Lower Hutt. Tel: 676 592



**NEW**

**MICRO-EYE**



**COMPU-HETERODYNE**

**THE WORLD'S FIRST RADAR DETECTOR  
WITH COMPUTER INTELLIGENCE**

THE **ONLY** RADAR DETECTOR WITH  
**MICROPROCESSOR** CONTROLLED  
SIGNAL DISCRIMINATOR

ALL ENQUIRIES TO (02) 666 4000

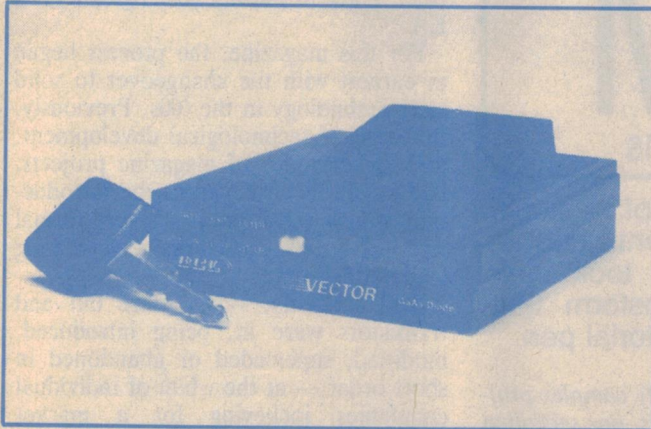
NEW 1986 MODELS NOW AVAILABLE INCORPORATING R.S.D.

- DISTRIBUTORS REQUIRED -





## MICRO EYE VECTOR



### Dash/Visor Model

Until now, **GaAs Diodes** have only been used in sophisticated military radar equipment. The MICRO EYE VECTOR is the first consumer electronics product equipped with this new technology.



## MICRO EYE MODEL 861

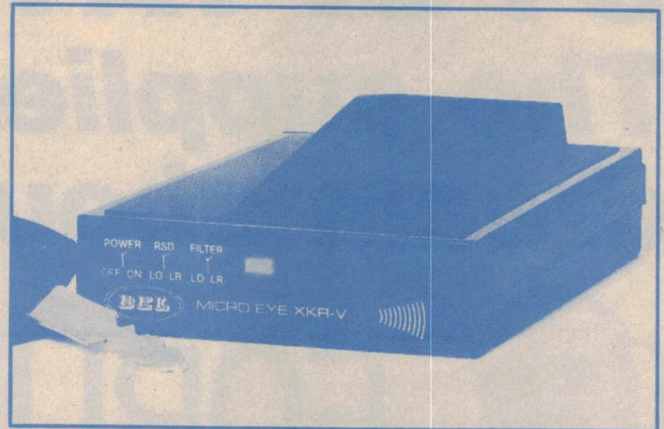


### Dash/Visor Model

### XKR-VI

Similar to the 860, the XKR-VI incorporates our exclusive **Superheterodyne** Horn-Microstrip hybrid circuitry, but without the luxury features.

## MICRO EYE MODEL 860



### Dash/Visor Model

### XKR-V

Powerful and precise, BEL's XKR-V was designed as the smallest, most compact **Superheterodyne** dash/visor detector in the world. Appealing, futuristic design, with our exclusive Horn-Microstrip hybrid circuitry, will enhance the interior of any vehicle.

## MICRO EYE MODEL 864



### Dash/Visor Model

### XKR-IX

**Superheterodyne** protection that fits in your pocket! Great performance and super value.





# UTOPIATRONICS:

## The supplier hobbyists dream about!



### FORUM

Conducted by Neville Williams

Wouldn't it be wonderful if electronics suppliers kept in stock, for an indefinite period, all the individual components hobbyists might need to build magazine projects that took their fancy. A Victorian reader would like us to transform that dream into renewed reality, with a stroke of the editorial pen.

To be sure, he doesn't express it in those terms but, in effect, he'd like us to turn the clock back to that Utopian period, when projects could remain current for years; when components were readily available off the shelf and able to be dispensed cheaply over the counter, to suit the whims and resources of individual buyers.

Many projects were indeed built up over a lengthy period in those halycon days BK (Before Kits) with parts swapped, or scrounged, or picked up on paydays, on the way home. But things have changed (for the worse). Says our correspondent:

*I have been a regular reader of EA for many years and I must voice my disappointment at the direction the magazine has taken in the last year or so.*

*I'll use the new Playmaster tuner as an example. For many months, I have been looking forward to this unit, although I suspected that it would be a "buy a kit or forget it" project, like so many others lately.*

*In my circle of friends I know of three who would like to build the tuner but no one will do so for one reason: we can't afford to lay out \$400 in one hit for a kit. Surely we are not the only ones in the land who can't lay out big dollars for kits based on articles from a magazine ostensibly aimed at enthusiasts and hobbyists.*

*I have built many highly complex projects from other magazines, one section at a time, with no large one-time outlay, eg computer-controlled frequency meter, preamplifier and power amplifier, parametric equaliser, &c. I am certainly not the only one who would prefer to build from an English rather than an Australian magazine.*

*I invite you to name one reasonably complex project described in EA recently that has PCB artwork, component suppliers, drilling details, &c.*

*I sincerely hope that EA changes back to the old ways because what was once a great magazine has been reduced to nothing more than a collection of kit manufacturing instructions.*

*When a group of hobbyists say "I hope another magazine brings out something as good as this tuner", it must tell you something! N.M. (Rosebud, Victoria).*

I can't deny that there has been a change in the content of some of our constructional articles but N.M. is wide of the mark if he believes that it is simply the result of a gratuitous change in editorial policy, or that it has occurred only in the last year or so.

In actual fact, the face of hobby electronics has been changing steadily over the past twenty years and magazines worldwide have had to adapt to it. Some haven't made it and have simply disappeared!

I know because, for much of that time, I was in the hot seat right here at EA.

For this magazine, the process began in earnest with the changeover to solid state technology in the '60s. Previously, the pace of technological development, and the currency of magazine projects, had largely been keyed to the introduction of new valve types — a very formal and unhurried procedure with a long lead and lag time.

But, suddenly, valves were out and transistors were in, being introduced, modified, superseded or abandoned in short order — at the whim of individual companies jockeying for a market share.

The longevity of magazine projects dropped from years to months and would-be constructors found themselves having to buy the parts when they were available, or risk missing out altogether. That still applies; neither magazine, nor stockist nor constructor can gamble on some particular components being available this time next year.

### Competition from imports

It was in the same formative solid state era that the Japanese electronics industry got moving, and flooded our market with mass produced test instruments, portable radios, audio equipment and amateur gear that looked the part, worked well, and cost less to buy than the components needed to build them!

It also had a profound effect on hobbyist attitudes and on licensed amateurs in particular.

Many simply settled for the built-up product but even inveterate home constructors were no longer content with the traditional "home-made" look; they demanded a PC board, chassis and case, and a fully finished front panel to lend a professional touch.

Faced with the need to order and stock these as special items, it was logical for suppliers to want to sell them



only as part of a kit; either that or not bother with them at all!

As it happened, most would-be constructors seemed rather to like the idea and we had no end of complaints from readers about having to chase up individual parts for projects that, for some reason, had not been advertised in kit form!

Really, it has little to do with us, apart from awareness that packaged kits were becoming popular. Our self-appointed task was to design and describe the project. How the parts were sold was more a matter for the vendor and customer.

## Company project kits

What about articles based on designs and kits originated by individual suppliers?

Our early policy was simply to review them if requested, but not to feature them, as it were, in competition with our own laboratory projects, in which all advertisers were free to share.

But there came a time when readers began asking about projects which, for one reason or another, we could not reasonably cope with. Some involved activities — model aircraft, boating, &c — which were beyond the scope of currently available staff. Others called for custom built hardware which would not be accessible to regular parts suppliers.

Yet a suitable project was often available in kit form from one source or another. To check out and feature such a kit would obviously assist those readers who might want to build it, while also interesting others who would merely like to read about the technology involved.

I personally made the decision at that time to change our policy, in order to broaden our coverage into areas which we could not hope to cover ourselves

without a totally uneconomic increase in laboratory staff.

That was many years ago and, since then, we have checked out and featured a wide variety of projects from overseas and local sources, with the idea of drawing them to the attention of would-be constructors and of enlightening those who merely like to read about such things.

The 100W VHF Linear Amplifier in the March issue is a recent example.

If, as a reaction to N.M.'s letter, we face a chorus of protest against such articles, I guess that Editor Leo Simpson will have to reconsider that earlier decision!

## The Playmaster tuner

As it happens, the AM/FM stereo tuner which is the focus of N.M.'s letter was born and bred in EA's own laboratory, after a gestation period of something like twelve months.

In terms of man hours, it was an extremely costly project but we had the satisfaction of being able to present it as literally the best AM/FM stereo tuner we had ever handled or measured. Moreover, the ultimate kit price of \$399 is both modest and attractive when compared with the cost of less highly specified commercial tuners.

Reading N.M.'s letter, one wonders how people get on who want to buy a good quality commercial tuner, or anything else around that figure, to use with \$1000-worth or more of domestic hifi equipment?

They certainly wouldn't have the option of buying it a bit at a time. I guess that they'd have to arrange for a bank loan or buy it on credit card. If I might borrow N.M.'s phraseology, the Bankcard and Visa card symbol at the bottom of the Jaycar advert for the tuner kit "must tell you something".

## Fragmented construction

Before writing this, I made a point of discussing with John Clarke, who did most of the work on the tuner, the idea of building it up in segments, as a way of spreading the cost. He was not impressed either from a technical or monetary point of view.

He pointed out that, in such a project, a great deal of care is necessary to ensure that there is no mutual interference between the AM and FM tuner functions and the control of display logic system.

Having decided upon a practical, slim-line presentation, it made good sense to concentrate most of the components on a single, large PC board, as a way of ensuring a fixed and proven layout. He would feel much less confident, he said, about a design involving a number of smaller boards which could be shuffled around and interconnected at the whim of individual constructors.

In any case, what could be temporarily omitted apart, perhaps, from the AM or FM section? It would be a tedious way, indeed, to delay spending a few dollars.

John also stressed that the tuner contained specialised components that are not normally available through parts suppliers and that are, in any case, likely to be very expensive if ordered on a one-off basis.

When a company such as Jaycar decide to "kit up" for the tuner, they have to "take a punt" on the number of tuners that may be built and place firm orders for all the special components and hardware.

Having "stuck their necks out" for perhaps thousands of dollars, a practical company could hardly be blamed for trying to optimise their investment by reserving the components primarily for their own complete kits.

As for Utopiatronics, I fear that it is likely to remain a nostalgic dream. What do you think?

## P.A. loudspeakers

Now for a change of subject: After writing three complete articles on small-scale public address systems, it could be somewhat frustrating to be reminded, however courteously, that you had completely overlooked an important aspect.

A letter to hand about P.A. amplifier systems is brief and to the point:

Dear Neville,

I read your articles on public address systems with great interest but was surprised that you did not make even a passing mention to low level loudspeaker



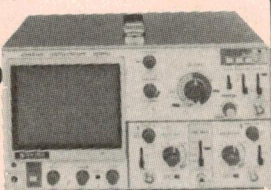


## Looking to purchase instruments

We are stockists of Hitachi, Fluke, Trio, Goodwill, Meguro, Aaron and Kikusui: so if you're in the market for an oscilloscope, think of David Reid.

### 20 MHz KIKUSUI COS5020 \$629.00

+ 20% Sales Tax  
INCLUDING TWO PROBES  
NOW WITH 2YR  
WARRANTY



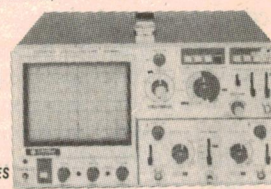
(Vertical Axis), 1-2.5 sequence, 10 range; Sensitivity, 5mV/DIV (within  $\pm 3\%$ ); Frequency response, DC (AC: 10Hz) ~ 20MHz ( $-3\text{dB}$ , 8DIV); Operation mode, CH1, CH2, DUAL, ADD, X-Y (DUAL automatic switching ALT and CHOP); (Horizontal Axis), 1-2.5 sequence, 20 ranges; Sweep time, 0.2  $\mu\text{sec}$  ~ 0.5sec/DIV (within  $\pm 3\%$ ); (with 10  $\times$  MAG), 20nsec ~ 50msec/DIV (within  $\pm 5\%$ ).

### 40 MHz KIKUSUI COS5041

Price  
On

Application

INCLUDING TWO PROBES  
AND DUST COVER



(Vertical Axis), 1-2.5 sequence, 10 range; Sensitivity, 5mV/DIV ~ 5V/DIV (within  $\pm 3\%$ ); Frequency response, DC (AC: 10Hz) ~ 40MHz ( $-3\text{dB}$ , 8DIV); Operation mode, CH1, CH2, DUAL, ADD, X-Y (DUAL automatic switching ALT and CHOP); (Horizontal Axis), (A: Main sweep, B: Delayed sweep); Sweep time, 1-2.5 sequence, A: 20 ranges, B: 11 ranges; A: 0.2  $\mu\text{sec}$  ~ 0.5 sec/DIV (within  $\pm 3\%$ ); B: 0.2  $\mu\text{sec}$  ~ 0.5 sec/DIV (within  $\pm 3\%$ ); (with 10  $\times$  MAG), A: 20n sec ~ 50m sec/DIV (with  $\pm 5\%$ ); B: 20n sec ~ 50m sec/DIV (with  $\pm 5\%$ ).

### ESCORT MULTIMETERS

EDM 1105 \$75.00

● 3 1/2 digits. ● Six functions: DCV, ACV, DCA, ACA, OHM, Diode Testing. ● 0.8% basic DC accuracy.

EDM 1116 \$100.00

● New model complete with transistor and capacitor tester.

EDM 1125 \$108.00

● 3 1/2 digits. ● Seven functions: DCV, ACV, DCA, ACA, OHM, Diode Testing, Audible Continuity. ● 0.25% basic DC accuracy.

EDM 1135 \$140.00

● 3 1/2 digits. ● Eight functions: DCV, ACV, DCA, ACA, OHM, Diode Testing, Audible Continuity. ● 0.1% basic DC accuracy.

EDM 1346 \$225.00

● 4 1/2 digits. ● Eight functions: DCV, ACV, DCA, ACA, OHM, Audible Continuity Testing, Diode Testing, Data Hold. ● 0.05% basic DC accuracy.

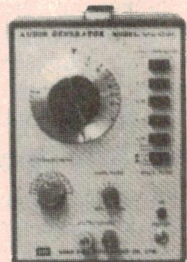


All multimeters + 20% Sales Tax

### GAG-808A AUDIO GENERATOR \$203.00

Covers 10Hz to 1MHz

● 20Vp-p open circuit output ● Sine and Square wave outputs ● External sync ● 600 ohm output impedance



ALL PRICES SHOWN DO NOT INCLUDE SALES TAX. ADD 20%

These are just a few of the many 100's of up-to-date Electronic items on display at:



**DAVID REID ELECTRONICS LIMITED**  
127 York Street, Sydney, 2000  
or Telephone (02) 267 1385

## FORUM - continued

systems; ie multiple loudspeakers, each operating at a low power level and each speaking directly downwards.

These have been in use for a number of years and have proved to be useful in halls with awkward acoustics. Although they do not have the directional effect of front located systems, they can give a very even spread of sound. It is often more important to be understood than to be heard from the right direction.

Also, the microphone can be used directly under the speakers right throughout the hall, with less feedback problems than many other systems.

They are particularly effective in halls with low ceilings or highly reverberant acoustics.

I will be interested to hear your comments on this system and why you omitted to mention it in your articles.

N.T. (Laverton, Vic).

While it is true that I did not specifically mention dispersed loudspeakers, the omission was conscious rather than accidental. Indeed, the concept was implicit in the reference, on pp22/23 of the November issue, to large scale professional line source systems involving up to a dozen high powered drivers.

In particular, I had in mind a pair of such systems that were installed many years ago in the Sydney Town Hall, high above the platform but effectively camouflaged by the massive pipe work of the grand organ.

Sydneysiders with a long memory might recall that, prior to the installation of the line source systems, dispersed loudspeakers were used, with downward inclined back-to-back pairs attached to the pillars supporting the galleries, and serving the floor level audience on either side. Other dispersed loudspeakers served the galleries.

In the huge, reverberant sandstone building, the multiplicity of sound sources could — and often did — add up to complete sonic confusion, with every syllable turning into a 2- to 3-second event. It presented particular problems with loud-talking, fast-speaking orators.

Substitution of an up-front line-source system at least helped to keep the direct and amplified sound in step and to beam the latter towards the audience rather than have it re-echoing from the lofty, domed ceiling.

Some large and architecturally complex cathedrals are still served by dis-

persed systems — or dispersed line source systems — but with the added refinement of digital delay units and local amplifiers. The idea is to keep the amplified sound heard by listeners more or less synchronised with sound emanating from the source, or from loudspeakers closer to the source.

Come to think of it, an interesting article could be written on this general subject but, of course, it is in a world apart from the small-scale system we were talking about in the Sept/Oct/Nov issues.

### In churches and halls?

In truth, I cannot recall ever having seen a dispersed loudspeaker system in a local church or concert hall. Nor could any of the people I asked, when N.T.'s letter came to hand.

For sure, you find them in department stores and supermarkets, in travel terminals and waiting rooms, in restaurants and coffee lounges but rarely, if ever, in churches or up-front presentation type situations.

As someone pointed out: walk into a club and you'll generally find a dispersed loudspeaker system being used for announcements and mood music. But, when a stage act comes on, they invariably use up-front sound reinforcement.

As N.T. suggests in his letter, it is vital to be understood but perhaps the directional qualities of the amplified sound are more important than he allows for. Rather than alternatives, they may both be imperatives.

There's one other very practical point: dispersed, downward facing loudspeakers can be installed most conveniently in structures with relatively low, false ceilings, with both lights and loudspeakers being mounted on ceiling panels flush with the undersurface.

Suspended from high ceilings, they would be unsightly, while mounting behind full, fixed ceilings could expose the cones to damage from wind gusts (or rodents, &c) in the roof space, unless individually boxed in.

Because of such considerations, the dispersed loudspeaker idea (branded by one acquaintance as the "Woolworths" system") was not mentioned in the series but N.T. might still have a point. There could be highly successful installations out there that we didn't allow for — or there could be failed systems.



# CUSTOM ICs

*In today's highly competitive market one of the biggest problems facing companies is the protection of their product designs. If product designs can be easily copied, other companies will soon do it. One way around this is to design the product with custom ICs. This article is a survey of the Australian custom IC market, describing the different types of custom ICs and how they are produced.*

by TERRY AYSCOUGH

## Introduction

Following the introduction of standard 54/74 Series TTL and other IC families in the mid 1960s, equipment designers were able to select from a wide range of economical "off the shelf" building blocks for use in both analog and digital systems. As experience and confidence developed, electronic circuitry was called on to perform increasingly complex and difficult tasks. This resulted in bigger and better printed circuit boards, which sometimes housed hundreds of standard ICs.

A reduction in the 'chip count' was promised in the early 1970s when large scale integration (LSI) technology became available. But it was soon found that the larger, more powerful devices, tended to have rather specialised, narrowly defined applications and lacked flexibility when compared to combinations of smaller devices.

Then the microprocessor was introduced and was hailed by many as the ideal solution, combining impressive power with highly adaptable signal processing capability. Subsequent experience has shown that software costs can be excessive. The micro is also disadvantaged by having to absorb some of

its own processing time and power to support internal operations.

And while a few applications for medium and large scale microelectronic devices such as telecommunications, consumer goods or the automotive market may need production runs extending into hundreds of thousands of devices, the vast majority of ICs are utilised in low volume products. This is particularly true in a country such as Australia, where users demand access to the latest technology, but equipment production runs are limited by the small market size.

Now, a new range of IC devices has quietly emerged from humble beginnings way back in 1971 and is becoming a very significant part of the semiconductor scene. These devices all have one feature in common; they allow the designer to specify how signals are handled within the chip. This is done either by physically changing connections within the IC, specifying final interconnections before the chip is packaged or by partial or full involvement at the pre-fabrication design stage.

We will take a brief look at the main technologies involved and review some

of the options and facilities which they offer. We hope it will also give the future user, whether he be an uninitiated designer, beleaguered service technician or blissful button-pusher, a clearer idea of these exciting new developments.

## Terminology

The whole area of custom ICs is confused by an abundance of names, abbreviations and jargon. Terminology varies, not only from one region of the world to another, but also between suppliers from the same country.

The first name tag which needs sorting out is the generic term for the whole range of customer controlled, specified or designed ICs. Readers will come across labels such as Custom Designed ICs, Custom-Specified ICs, User Designed/Programmable ICs, etc. The name Application Specific Integrated Circuits (ASICs) seems to be accepted and used by most of the major microelectronics suppliers in Australia and is the terminology adopted for this article. Fig.1 shows how ASICs can be further classified into a number of distant family groups.



# Device families

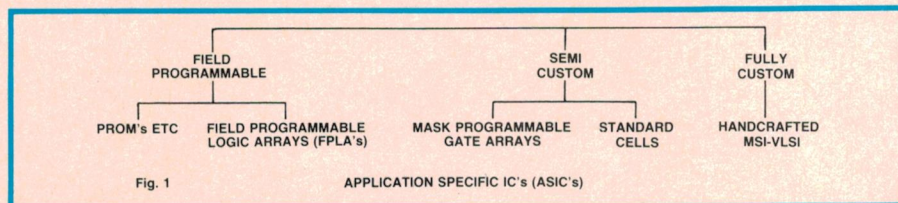
The lefthand side of Fig.1 covers devices having functions which can be changed after they have been purchased fully packaged and tested from the manufacturer. These are known as field or user-programmable ICs.

Programmable read only memories (PROMs) come in a variety of types. Some can be programmed by applying special input signals and may be erased and re-programmed as required. The reader will probably be familiar with names such as Erasable Programmable ROM (EPROM), Electrically Alterable ROM (EAROM), and so on. Memory devices of this type decode the input signal and then use an OR matrix to provide the required outputs in a pre-defined truth table relationship. The characteristics of PROMs and the applications for which they are best suited set them apart from other ASICs. As they are also fully covered in most publications dealing with microelectronics, we will not spend further time discussing them here.

The second family of devices shown on the left in Fig.1 are the field programmable logic arrays (FPLAs). With these ICs, the manufacturer produces a standard fully packaged chip, which has a large number of inter-connections covering all probable customer requirements. The user 'programs' the device to obtain the desired architecture by injecting carefully controlled pulses of current through selected pins. These pulses melt internal fuse links, disconnecting unwanted functions.

The middle sections of Fig.1 show two further families of devices under the general heading of semi custom.

Mask programmable gate array chips, like FPLA chips, are produced to a standard format, but the final processing which would inter-connect components to form gates or gates to form logic arrays is not completed. When a customer wishes to purchase a quantity of devices, the exact logic required is specified and the IC manufacturer designs a suitable chip wiring layout to provide this. The standard format chips then have final masking and etching operations carried out, which leaves metal tracks selecting and inter-connect-



ing sections as required.

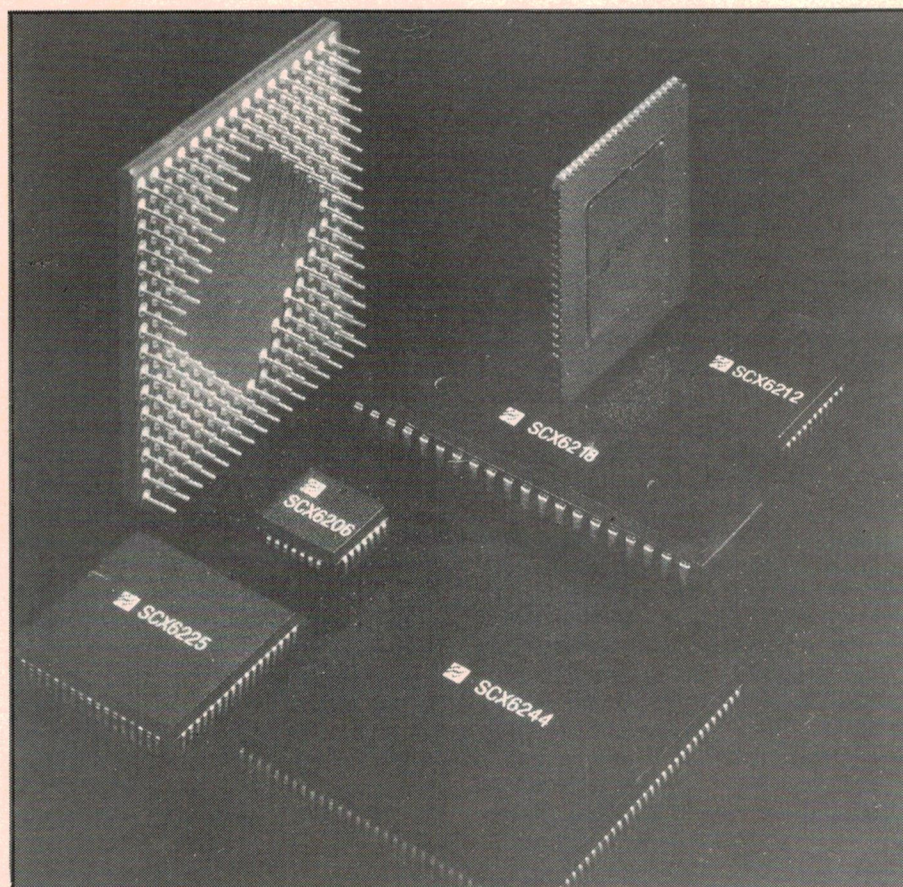
With the standard cell family of semi-custom devices, there is no pre-fabrication of chips. Detailed designs for a large number of tried and tested logic elements or cells such as gates, flipflops, op amps, and so on, are stored in a computer 'library'. When the user specifies the logic functions required, complete chip designs with suitable inter-connections are assembled and evaluated by a complex software program. When satisfactory results are indicated, the computer prepares a full set of masks to fabricate the IC. From this point on, the processes are similar to those for an 'off the shelf' product.

American literature often classifies

standard cell ICs as custom products, but in Australia they are generally considered to be in the semi custom group.

The righthand side of Fig.1 shows fully custom devices. In this case, the customer and IC manufacturer get together and develop a no-compromise design, in which every detail, down to individual components on the chip and pin connections on the package, are tailored to meet a specific application. Such devices are often said to be 'hand crafted', for reasons to be covered later.

Figures 2 and 3 take a brief look at current IC technology and some readers may like to update their knowledge in this area before moving on for a detailed review of each device family.



National Semiconductor have a 2-micron gate array family with 600 to 6000 gates in packages up to 172 pins. These ultra-fast devices have gate propagation times below one nanosecond and have reduced chip cost by virtue of being made on 6-inch wafers. (Photo by courtesy of National Semiconductor (Aust) Pty Ltd.)



# Field programmable logic arrays

A field programmable logic array consists of a number of gates, buffers and sometimes various types of flipflops plus chip-enable facilities and so on. A small FPLA device might have provision for about 10 inputs and 4/6 outputs. Larger arrays might provide up to 22 inputs and 10 outputs. Most FPLAs come in a 20 to 28-pin package.

Some of the smallest devices currently available contain the equivalent of 150/300 2-input gates, whilst the largest devices offer up to 5000 gate equivalents. Device time delays are typically 15 to 35 nanoseconds and chip power consumption runs from 0.5 to 1.0 Watt.

Manufacturers' literature uses a variety of names to describe FPLAs. Some examples are fuse (or field) programmable logic devices (FPLDs, FPLs or PLDs);

Programmable array logic (PAL — Monolithic Memories Inc) and Integrated fuse logic (IFL — Philips/Signetics). Some FPLAs contain clocked bistables, etc, and these are often termed programmable logic sequencers (PLSs) rather than PLAs.

The majority of present day FPLAs use TTL logic elements with nichrome fuse links in the inter-connecting circuitry. A user programs the chip to meet his specific requirements by passing current between certain pins. This permanently burns out selected links, but leaves others intact, providing the architecture required. The construction of a

typical nichrome fusible element is shown in Fig.4.

A simple illustration of how circuit functions can be altered by fuse links is provided in Fig.5. The exclusive OR gate has an input signal supplied to A and output is taken from Z. B can be either high or low depending on whether fuse F is intact or blown.

The truth table shows a normal ex OR input/output relationship.

If the fuse F is intact, input B of the ex-OR gate remains low and reference to the truth table shows that input and output signals are always identical. The circuit is thus operating as a non-in-

By blowing a fusible nichrome link in the interconnecting circuitry, gates in a field programming logic array can be configured as inverters or buffers.

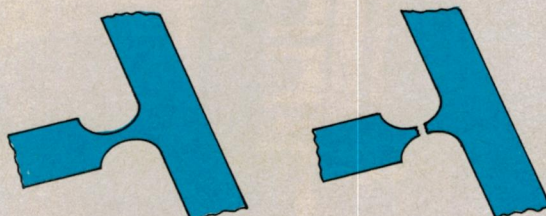


Fig. 4

## Hybrid 9

### can bring out the Spielberg in you

The Hybrid 9 is so versatile that it is impossible to describe all its features in one advertisement. Use the switches, edits, fades, wipes, dissolves and dubbings used in film studios and video production houses at a fraction of the cost of professional gear.

**Fade to Black**  
Half second to more than five seconds, the picture fades with perfect control. Combine wipe and fade for 31 special effects.

**Video Switcher**  
Switch inputs with special effects, at the touch of a button.

**Video Window Remote Control**  
Joystick the box wipes around the screen to highlight titles or frame part of the picture.

**Enhance**  
Can improve the performance of 1/2" or 3/4" VCRs. Make up to 3 stereo dubbings at the one time. Can reduce snow and static. Enhances broadcast programs with a split screen to view the effect.

**Special Effects Generator**  
5 basic wipe patterns. A total of 15 wipe patterns is possible.

**Audio Dissolves and Video Breakaway**  
Fade in and out of sync with the video or add your own stereo audio track.

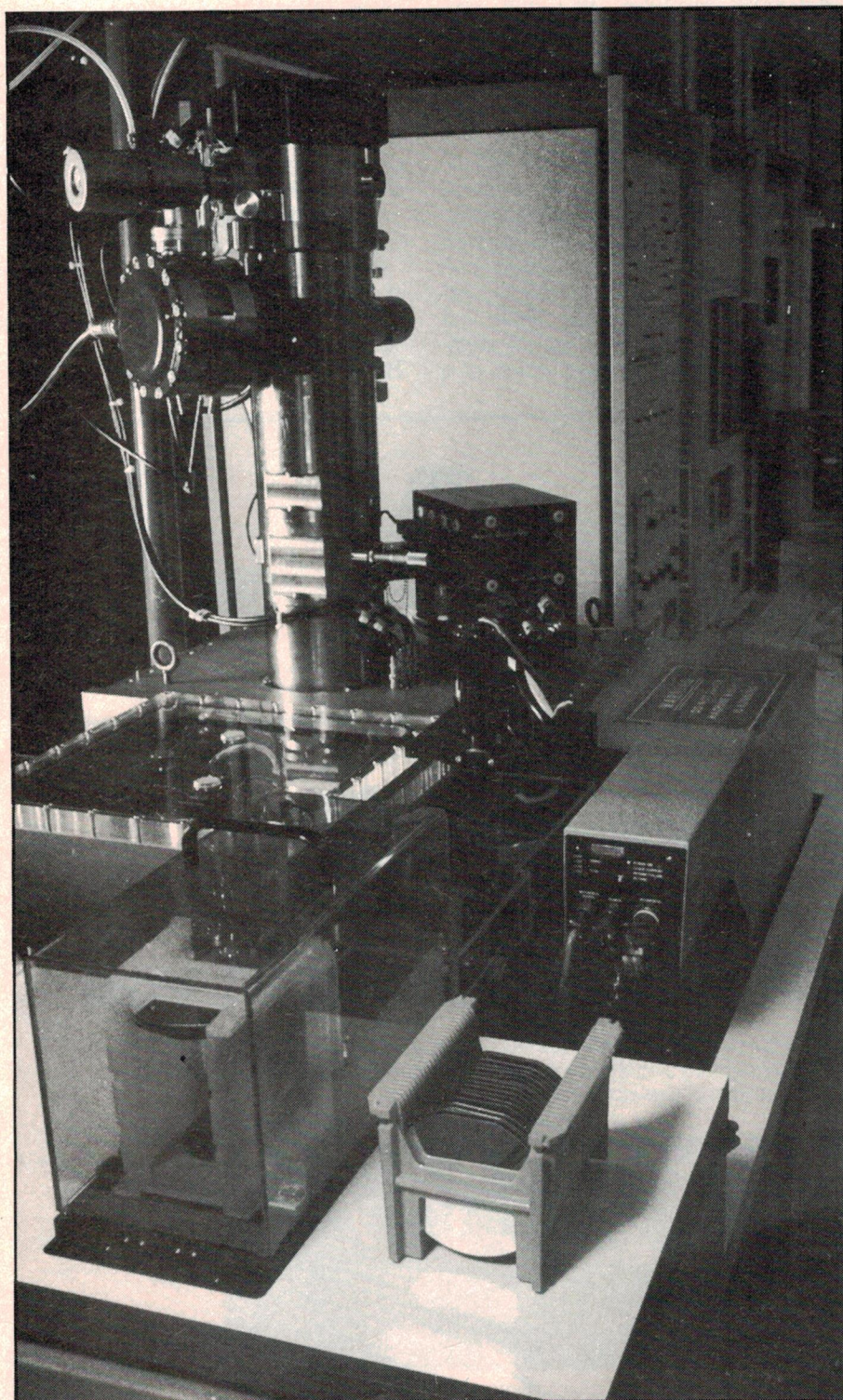
Trade enquiries welcome. Please ring —  
**ODYL GROUP LIMITED, on (03) 846 3022**  
112 James Street, Templestowe, Vic., 3106.  
Sydney (02) 21 2661 Brisbane (07) 394 8259



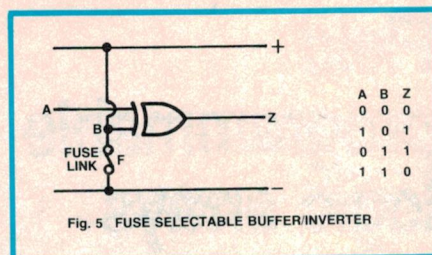
I am excited about Hybrid 9. Please send me your re-usable video tape explaining its many wonderful qualities. I enclose \$12.00 to cover the cost. (Refundable on return.)

Name \_\_\_\_\_ Address \_\_\_\_\_ Phone \_\_\_\_\_





Texas Instruments' E-beam process can be regarded as akin to a souped-up electron beam microscope. The high power beam is used to directly write the patterns onto resist-coated wafers. (Photo by courtesy of Texas Instruments.)



verting buffer. If fuse F is open circuit, B will go high and the truth table shows that input A and output Z will now have opposite polarity. In this condition, the circuit operates as an inverter. This system is often used to allow selection of input or output polarities on FPLAs.

By using FPLAs as an alternative to 'off the shelf' SSI or MSI devices, equipment designers gain a number of advantages.

Firstly, FPLAs offer more flexibility for the designer to implement the logic required, without being left with large numbers of half-used ICs. In a typical application an FPLA will replace between 5 and 30 standard logic ICs.

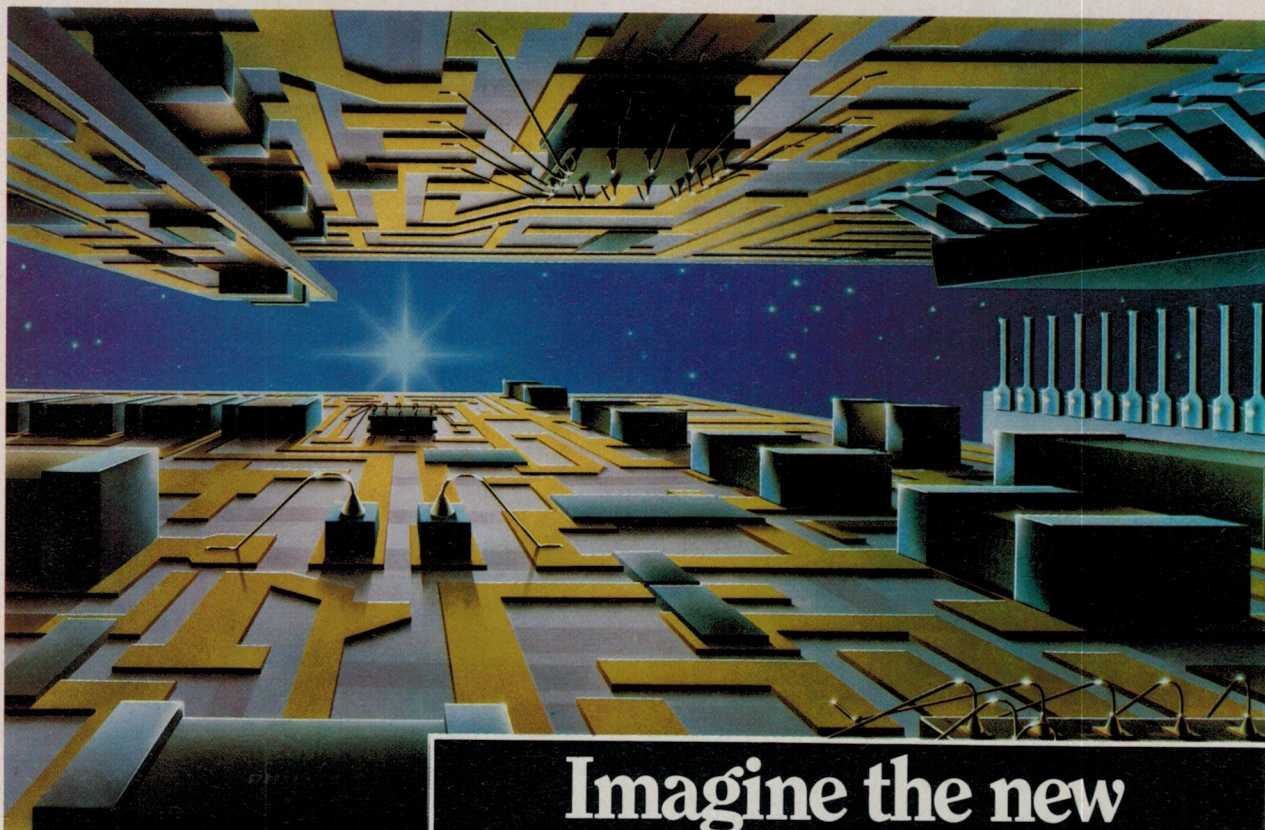
The use of FPLAs gives the equipment designer increased control over system architecture, encouraging unique and competitive approaches. A personal computer with a relatively simple software program can be used to map out the fuse pattern required in a few hours. When the pattern is known, actual programming of the device takes only a few seconds. This makes it fairly easy to experiment with and evaluate different solutions to a logic problem, or to modify and update programming during equipment production runs.

A typical FPLA programming software package offered by Philips/Signetics goes under the acronym AMAZE, which stands for "automatic map and zap equations".

FPLAs also have the big advantage that the programming used is known only to the equipment manufacturer, thus keeping innovative designs secret and making them difficult to copy.

Because a semiconductor manufacturer can produce and stockpile FPLA ICs in the same way as standard devices, there are worthwhile economies of scale. Advanced Micro Devices of California have recently extended this concept by replacing a range of 13 first generation field programmable devices with a single, more flexible, second generation product.





You can come on an incredible journey, not to the future, but to a technology available today for innovative electronics users. Philips, custom design and manufacture right here in Australia, both hybrid circuits or custom I.C. chips, to suit your budget and product concept.

Access to reliable hi-technology at very competitive cost even in modest production quantities.

Tell the Philips Elcoma designers what you are trying to achieve and they will create for you a unique microcircuit solution. Perhaps you already have a design. That's where Philips 50 years of continuous production experience in Australia will ensure an efficient result. Naturally, your product design security is always assured and the resulting microcircuit is exclusively your own property.

Philips years of practical experience in computer aided design (CAD/CAM) will get you off to a good start. Your new electronics package will require little space, will improve reliability and the performance of your "new product." At the same time it will provide you with more features and added benefits for your customer, and protect your design against "copycats"!

## Imagine the new business opportunities with Philips custom microcircuits

The time it takes, from engineers briefing to delivery of your first electronic microcircuit or micro sub-assembly, will pleasantly surprise you. Design sampling and testing may be as little as 8 to 10 weeks for hybrid circuits. More advanced custom "monolithic chip" designs will take longer, depending on the size of the chip and complexity of the design.

**Send off the coupon today** or call Philips Electronic Components & Materials to get the ball rolling on the improvements you'd like to make to your product.

<b>Sydney</b>	<b>(02) 439 3322</b>
<b>Melbourne</b>	<b>(03) 542 3333</b>
<b>Adelaide</b>	<b>(08) 243 0155</b>
<b>Perth</b>	<b>(09) 277 4199</b>
<b>Brisbane</b>	<b>(07) 44 0191</b>

*We make electronics in Australia*

I'd like to explore the benefits of Philips microcircuits in my products. EA

My area of interest is \_\_\_\_\_

Name: \_\_\_\_\_

Organisation: \_\_\_\_\_

Address: \_\_\_\_\_

Postcode: \_\_\_\_\_

Phone: \_\_\_\_\_

Send to: Philips Elcoma, 11 Waltham Street, ARTARMON, N.S.W. 2064.

the UN108



**Electronic  
Components &  
Materials**

**PHILIPS**



# Subscribe NOW to Electronics Australia and **WIN!!!**

This superb Sony Hi-Fi and Video combination  
could be yours!

**Worth over  
\$10,000!!**

Subscribe for  
2 years and enjoy a  
special saving of  
almost \$6!

By subscribing to Electronics Australia, you may very shortly be relaxing in front of your own Sony system, enjoying the superb listening pleasure that can only come from Compact Disc technology, and while basking in richer listening pleasure you could be watching, filming, or recording your selection using your new Sony Video-8 video system, both systems designed to be fully integrated with each other.

This magnificent Sony Component System represents true, leading edge, technology. The 100 watt RMS per channel integrated stereo amplifier will give you plenty of power and can reproduce the most demanding in CD fidelity. The discrete three head design stereo cassette deck will improve

the faithfulness of your recorded sound. Improved frequency response will be evident as your AM/FM precision quartz tuner eliminates interference. With 20 key direct music selection and infra red remote control, the Digital Compact Disc player satisfies your most demanding requirements in fidelity and convenience. The digital compatible APM speaker system has been specially designed to cater for near perfect CD reproduction. A 20" high resolution Profeel monitor, including speakers, represents the best in video display monitors while the complete Video-8 system combines quality with portability. To complete the finishing touches a tuner/timer for the PAK 88 system is included.



## IMPROVE YOUR LIFESTYLE BY MAXIMISING YOUR LISTENING AND VIEWING PLEASURE!

By subscribing to Electronics Australia you will be kept up to date with feature-packed articles, the latest news and everything that Electronics enthusiasts, like you, need to know. There are always new techniques, new products and helpful stories to improve your knowledge and round-off your education.

Having Electronics Australia delivered to you direct ensures you receive every issue without fail and saves you the time you would otherwise have to waste by having to go out and buy it.

### **YOUR FREE GIFT — JUST FOR SUBSCRIBING!**

Your Electronics Australia team have gone to great trouble to select a special extra added bonus that you will find is really useful. This super-versatile Swiss Army Knife has seven different features — from a wire stripper to a can opener — and is that indispensable tool you'll find hard to do without.

The Swiss Army Knife features include a large blade, small blade, can opener, screw driver, cap lifter, wire stripper and key ring.



## WIN THE HI-FI/VIDEO SYSTEM OF YOUR DREAMS. **HURRY — THIS IS A LIMITED OFFER.**

Simply complete the subscription card in this magazine and send it FREE to us. Within six weeks you will receive your Swiss Army Knife and be enjoying articles in the first of your home-delivered **ELECTRONICS AUSTRALIA** magazine.

### **YOUR NO-RISK GUARANTEE**

If, for any reason you are not completely delighted with **ELECTRONICS AUSTRALIA** . . . simply let us know, and we'll gladly refund the unused portion of your subscription.

### **YOU MUST ACT NOW**

NSW Permit No TC86/532 issued under the Lotteries and Art Unions Act, 1901  
VIC Raffles and Bingo permits Board Permit No 86/270 issued on 13/3/86  
ACT Permit No TP86/162 issued under Lotteries Ordinance.  
(Offer valid until 31 August, 1986.)

The exciting prize draw is also open to all subscribers who renew before the closing date. If the prize is not claimed within 12 months, a second draw will be run.



# Mask programmable gate arrays

In Fig.1, the group of technologies labelled semi custom are divided into two sub-groups, mask programmable and standard cell. Now let us take a closer look at the first of these sub groups.

Mask programmable devices, like FPLAs, incorporate a wide variety of gates, buffers, registers, etc, but sometimes also include additional functions such as Schmitt triggers, oscillators, op amps and occasionally, RAM.

The major difference between mask programmable ICs and FPLAs, from the user point of view, is that with mask programmable devices the selection and interconnection of elements can only be undertaken at the device manufacturer's plant. This means that lead times be-

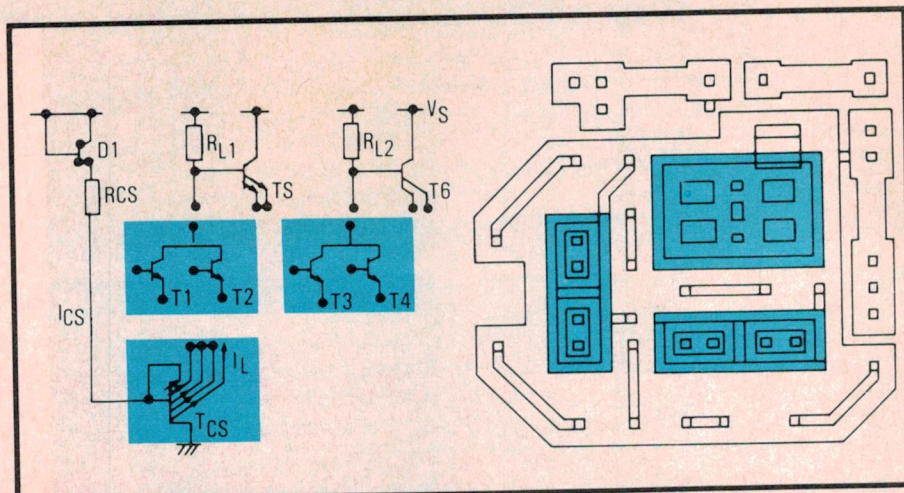


Fig.6 shows how cells can be connected together to provide various logic circuits. (Diagram by courtesy of Ferranti Electronics Ltd.)

come typically 4 to 8 weeks, rather than the hour or two for FPLAs, and economic quantities are about 10 times greater, starting at about 50 and extending to several thousand units.

When ordering a new device an equipment designer specifies the basic IC characteristics he requires, either by providing a logic schematic, by using appropriate design-capture software on his own personal computer or through computer aided design (CAD) work station facilities at a manufacturer's design centre. Companies offering full local CAD facilities include AWA Microelectronics in Sydney and NSD Australia (National Semiconductor Technology) in Melbourne. Several other IC manufacturers make available CAD software for use on customer's own PCs or plan to introduce local workstation facilities in the near future. The use of high speed data links for communications between local workstations and mainframe computers in design centres around the world is also becoming commonplace.

When a satisfactory design has been achieved, the stored information is used to drive a computer aided manufacturing (CAM) sequence, which produces the one, two or sometimes three masks required to complete the chip.

## Gate arrays

Mask programmable devices are variously known as uncommitted logic arrays (ULAs), master slice arrays or simply gate arrays. Monolithic Memories market devices called hard array logic (HAL), which are masked versions of their PAL IC's, covered in the previous section. In this case, fuse programmed versions of the chip can be used to de-

velop and verify the design.

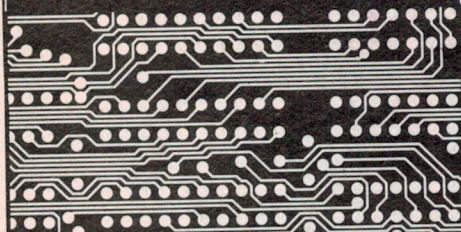
A gate array chip is usually laid out with orderly rows of circuit elements (cells) occupying the central areas and interface circuits and connecting pads around the edges. The cells may be made up of separate components such as transistors and resistors, which can be wired up as required to provide different functions, or ready wired to perform standard operations such as NAND and NOR gates, etc. The former are often known as uncommitted component cells and the latter as uncommitted functional cells.

The English company, Ferranti, was one of the pioneers of mask programmable gate array technology and their chips incorporate both uncommitted component and functional cells. Fig.6 shows a cell containing separate components in both circuit symbol and silicon layout form. It will be seen that by suitably interconnecting the components, a variety of functions such as two 2-input NOR gates, etc, can be created.

Fig.7 shows a second Ferranti cell, in this case a fully wired Schmitt trigger circuit. This is used as an input interface and is located at the edge of the silicon chip. Note the ground, VCC and other bus connections, plus the large lead connecting pad for the input signal.

Present day mask programmable gate arrays utilise a whole range of semiconductor technology, extending from TTL and ECL to NMOS and CMOS. At the moment CMOS is favoured for most new products, especially where the latest device geometries of 2 microns or less, giving improved chip densities and operating speeds, can be used to advantage. The future for bipolar devices

## PROFESSIONAL P.C.B. DESIGNS from R.C.S. DESIGN PTY. LTD.



the best equipped CAD bureau in Australia  
HIGHEST QUALITY □ FAST TURNAROUND  
DESIGN PRACTICES TO AUST. STANDARD  
PHOTO TOOLS □ DRILL TAPES  
CIRCUIT DIAGRAMS □ DOUBLE SIDED  
MULTILAYER □ FINE LINE  
PROJECT DESIGN AND DOCUMENTATION  
PHOTO PLOTTING OF MICRO CAD OUTPUT  
DESIGN CONSULTING SERVICE

For details contact:



**R.C.S. Design Pty. Ltd.**

728 Heidelberg Road  
Alphington, Victoria, 3078  
(03) 49 6404



# Special Privilege Offer

## SUBSCRIPTION CARD

### SUBSCRIBE NOW!!

You'll get 12 issues of *Electronics Australia* delivered FREE to your home, or 24 issues at a special discount price, PLUS A HIGH QUALITY SWISS ARMY KNIFE! (Worth A\$14.00)

AND ...

### YOUR CHANCE TO WIN THE ULTIMATE SONY DIGITAL AUDIO/VIDEO SYSTEM (Worth \$10,000)!

... ALL FOR ONLY \$35.40 for 12 issues (NZ A\$52.20 surface mail; A\$57.00 air mail) OR \$69.90 for 24 issues (NZ A\$98.50 surface mail; A\$108.10 air mail). (Card valid in Australia and NZ only. Overseas rates on application.)  
SUBSCRIBE NOW FOR TWO YEARS AND YOU GET TWO CHANCES TO WIN!!

**YES!** Please send me this special offer of ☐ 12 issues ☐ 24 issues of *Electronics Australia* magazine (one each month)

☐ I enclose my cheque/money order for \$\_\_\_\_\_ (with this card in an envelope and mail to: Freepost No. 4 at the address overleaf — NO STAMP REQUIRED if posted in Australia)  
OR Charge my ☐ Bankcard ☐ Visa ☐ Mastercard  
☐ American Express account with \$\_\_\_\_\_

Card No:

--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

Signature **X** \_\_\_\_\_ / Expiry date: \_\_\_\_\_  
(Unsigned credit card orders cannot be accepted)

Name

Mr Mrs Miss Ms

Initial

Surname

Address

Postcode

Please allow up to 6 weeks for delivery of your first issue plus your FREE GIFT  
(Offer valid until 31st August, 1986.)



**Electronics  
Australia**

**POST  
FREE**

No stamp required  
if posted  
in Australia

**FREEPOST No. 4  
The Federal Publishing Company Pty Ltd  
P.O. Box 227,  
Waterloo, NSW 2017**

---

**SAVE OVER \$5.00 – SUBSCRIBE FOR 2 YEARS**

---



seems to be in more specialised areas such as combined analog/digital chips, difficult interface situations, etc.

### E-beam scanning

An interesting technical development offered by Texas Instruments (TI) is a process called "E-beam scanning". Instead of preparing one or more photographic masks to determine the metallisation pattern on a chip, TI use electron beam scanning to directly write the pattern onto resist-coated silicon wafers. This process is claimed to reduce the time between verified chip layout and supply of tested prototype ICs to only two weeks. The process is done in Bradford, UK, so Australian users

might need to add a few more weeks for freighting, customs clearance, etc. A minimum order quantity of 300 devices is required.

Programmable gate arrays represent a major growth area for the world micro electronics industry. Typical mask programmed ICs can contain the equivalent of between 350 and 10000 two input gate circuits. When it is realised that a modest 700 gate equivalent chip could replace up to 40 standard ICs, the economics of using three devices in medium volume applications becomes obvious.

Disadvantages of mask programming include under utilisation of the silicon chip area and degradation of potential

device speed.

On an average mask programmed chip, only 80/90% of available function cells are used. In addition, wide spaces must be left between each column to allow for the maximum possible number of interconnecting leads. Both problems waste space and result in larger than necessary chip sizes.

Device speed can suffer because long parallel interconnecting leads will create additional stray capacities and these have to charge or discharge before logic levels can change.

Both of these problems are taken care of by standard cell technology which is the second semi custom approach shown in Fig. 1.

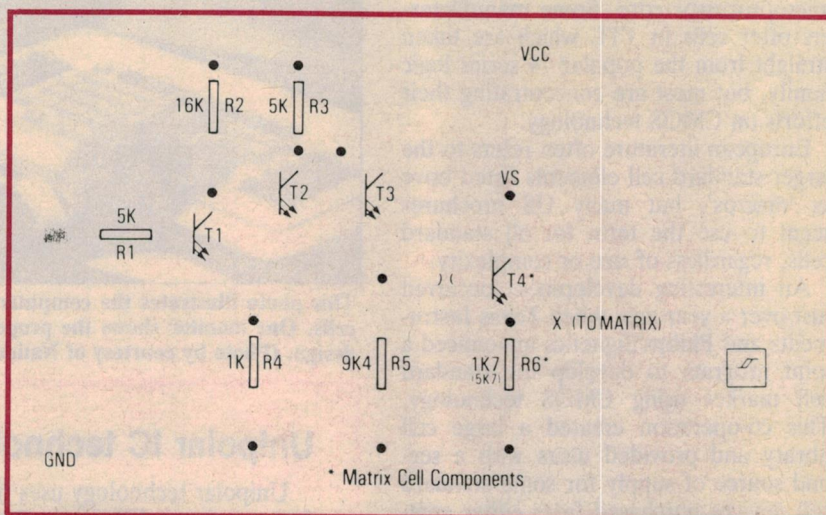
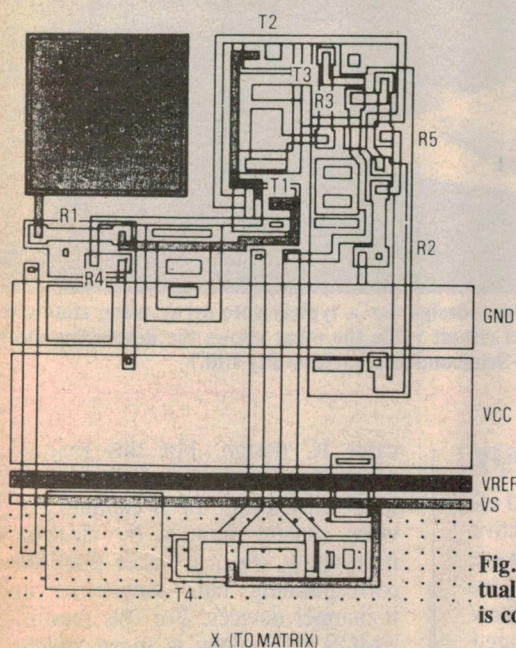


Fig.7 Uncommitted logic arrays use standard peripheral and matrix cells to produce virtually any wanted circuit configuration. These two diagrams show how a Schmitt trigger is configured. (Diagrams by courtesy of Ferranti Electronics Ltd.)

## Standard cell ICs

In preceding sections we have seen that with FPLAs, the manufacturer can produce and stock a fully completed IC and with mask programmable devices, an almost completed chip, before the customer comes along. With standard cell technology, no processing of silicon takes place until a design, which fully meets the customer's requirements, has been developed and finalised.

The semiconductor manufacturer has available a "library" of tried and tested

designs for the various circuit elements which make up a modern digital or analog IC. These might range from simple resistive dividers for providing bias voltages, through to the conventional types of gates and then to D-to-A converters. This library of circuit elements and associated specifications is held in a computer file.

An equipment designer wishing to order a standard cell IC will start by following similar procedures to those already outlined for mask-programmed arrays. Logic schematics may be developed and captured by a relatively simple software program running on the user's own PC. However, library access, circuit element layout and interconnection, performance simulation and veri-

fication all require the facilities of more powerful CAD equipment which may only be available at a manufacturer's design centre. The equipment designer then faces the choice of becoming deeply involved in CAD procedures or handing over his design at the logic schematic level for implementation by the IC manufacturer's expert engineers.

When each digital or analog circuit element is implemented in silicon, it will occupy a certain minimum area on the chip. Smaller circuit elements are normally assembled in vertical columns with bus connections running up and down. Efficient layout of the chip requires that elements have a common width, although height may vary as required to fit in all the necessary



components.

Each circuit element thus has a small rectangular compartment or area on the chip to itself and this is known as a cell. Fortunately, most of the world's semiconductor industry seem to have agreed on the single term 'standard cell' to describe this technology.

A check through IC suppliers' brochures and data sheets show typical libraries containing 100 to 200 standard cell designs, with most promising further additions in the near future. Cell functions listed include capacitor and resistor arrays, gates of all varieties and sizes, multi-bit storage and shift registers, counters, multiplexers, op amps, oscillators of various types, blocks of ROM and RAM and even a complete microprocessor core. Some manufacturers offer cells in TTL which are taken straight from the popular 74 series logic family, but most are concentrating their efforts on CMOS technology.

European literature often refers to the larger standard cell elements listed above as 'macros', but many US brochures seem to use the term for all standard cells, regardless of size or complexity.

An interesting development occurred just over a year ago, when Texas Instruments and Philips/Sigmetics announced a joint program to develop the standard cell market using CMOS technology. This co-operation created a large cell library and provided users with a second source of supply for some standard cell devices purchased from either company.

Standard cell ICs are available with processing power ranging from about 500 to 10000 equivalent 2-input gates which is similar to present day gate arrays.

Although the use of standard cells streamlines the design process, each IC must be fabricated from the ground up. This means that CAM costs can be significantly higher than for mask programmed gate arrays. The higher front end costs are compensated for by more efficient use of the chip however, and savings in the silicon area can result in the overall cost per gate being about 30% less than for comparable arrays. These savings become very significant when production runs of several thousand ICs are involved.

On the minus side, increased complexity at the CAD and CAM stages consumes time as well as money and designers may have to wait 3/4 months before tested prototype ICs are available.



This photo illustrates the computer-aided design for a typical gate array using standard cells. One monitor shows the proposed circuit while the other shows the developing chip design. (Photo by courtesy of National Semiconductors (Aust) Pty Ltd.)

## Unipolar IC technology

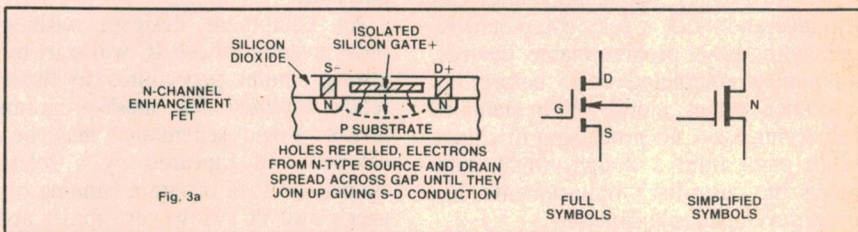
Unipolar technology uses field effect transistors (FETs) as the active elements. Originally the FETs were of the metal oxide insulated gate type and although these are now being superseded by oxide isolated silicon gate types, the name metal oxide semiconductor (MOS) is still used.

FET's may be of the N-channel or P-channel enhancement or depletion mode type. Depletion mode operation requires a gate voltage of opposite polarity to the drain/source voltage, which compli-

cates IC design. For this reason, most designers favour enhancement mode operation. In N-channel devices current flow is by electron movement, which is faster than the corresponding hole movement in P-channel devices. For this reason, NMOS technology is more widely used than PMOS.

The construction of a typical N channel enhancement FET is shown in Fig. 3(a). Note that construction of a P-channel FET is similar (Fig. 3(b)) except that all doping (P-type or N-type) and supply polarities are reversed.

With the development of large





# Fully custom ICs

Fig.1 might suggest that there is a clearly defined boundary between standard cell and full custom technology, but this is rarely the case in practice. Basically, a device is described as full custom when some or all of the functional circuit elements are designed from square one. Design work of this type would always be done by using a sophisticated CAD system and this would probably also access files containing details of previously successful macro cell designs. There would be little point in disregarding this information and re-inventing the wheel each time a new IC was designed.

Fully custom or handcrafted designs need not contain any of the compromises or technical expedients available in array and standard cell designs. Electrical parameters can be chosen to suit the specific application, chip layout can be optimised to give high device speed,

minimum cost per gate or exceptional reliability and packaging can be purpose designed to fit in with equipment requirements.

This ability to get the maximum possible from available technology is resulting in the emergence of some clearly defined roles for fully custom devices.

The very efficient utilisation of chip area means custom ICs can provide the lowest cost per gate figures obtainable. This is only true if the high initial development costs are amortised over a large number of units however, and VLSI custom devices come into their own economically when production runs exceed 100,000.

There are a number of highly specialised applications, particularly in the medical and defence areas, where standard or semi-custom technology cannot provide the necessary performance. Medical applications such as implanted pacemakers, need ICs with extremely low power consumption and exceptionally high reliability. Defence electronics must also be highly reliable and capable of surviving mechanical shocks, extremes of temperatures and other forms of abuse which would cause normal de-

vices to wilt and die.

Fully customised ICs also offer total security of design and this is important, not only in military, but also increasingly in commercial applications.

One of Australia's leading IC custom design and fabrication facilities is provided by AWA Microelectronics at North Ryde, near Sydney. AWA have been designing and manufacturing ICs since 1965 and now provide a well equipped Client Design Centre, supporting gate array, standard cell and full custom CAD activities. Equipment includes a VAX 11/785 mainframe computer, Daisy workstations and very impressive Calma full colour high definition graphic displays.

When a client approaches AWA Microelectronics to have an IC designed and manufactured, an applications engineer is assigned to advise and liaise until final completion of the project.

The customer's logic design can be fed into the CAD system as either a schematic diagram or in Boolean Algebra form. The first phase is to simulate, debug and verify the logic design. When this has been done, a floor plan of the chip is developed and modelled with

scale and very large scale integration (LSI and VLSI) devices, it became necessary to further reduce power consumption. The answer was provided by complementary MOS (CMOS) designs.

In typical CMOS circuits, N and P-channel enhancement mode FETs are used together. The circuit of Fig. 3(c) shows a simple gate arrangement. A high input on A will turn T1 off and T2 on, which takes the output low. A high input on B will turn T3 off and T4 on, again taking the output low. Lows on both inputs will cause T1 and T3 to conduct but will keep T2

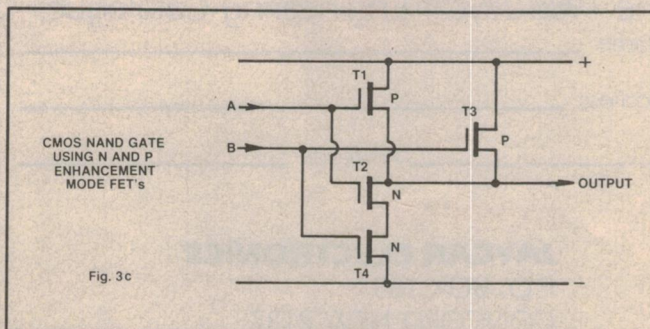
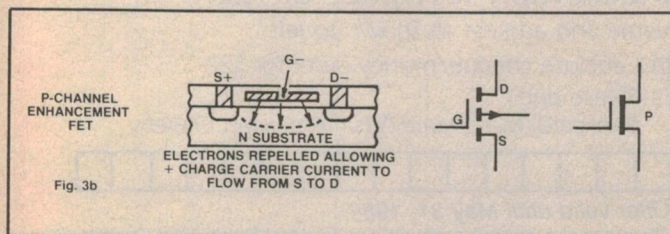
and T4 off.

Note that whatever the combination of input signals, one of the lower transistors T2 or T4 or both of the upper transistors T1/T3 will be off. This means there is never a steady current path between the positive, and negative supply rails and power is only consumed for a brief period during switch-over when both transistors are on.

CMOS is rapidly becoming the industry standard, replacing NMOS

and in some applications, bipolar technology. Speed and efficiency are being improved by progressive scaling down of device geometrics, with 2-micron structures as the current state of the art.

Despite its slightly greater complexity, development and fabrication costs for CMOS are now competitive with other IC technologies and early problems with temperature stability and linearity in analog circuits have been overcome.





# Jaycar

## ELECTRONICS

# 1986

# ENGINEERING CATALOGUE OUT NOW!

The brand-new 100 page 1986 Jaycar Catalogue is cram-packed with thousands of items. We have hundreds of new products for 1986. You can secure your copy **NOW** by simply sending a large SAE or posting the coupon below.

★ ★ **SPECIAL EXCLUSIVE OFFER!!** ★ ★

You can save **\$11** off 12 issues of **Electronics Australia** (at the cover price of \$2.75!). Fill out the form below and receive not only the Jaycar Catalogue for **FREE** but **EA** for 12 months **POSTAGE INCLUDED** for only **\$22**. This is the cheapest current subscription to EA available.\*

\*NOTE: This is an exclusive Jaycar/EA offer and is NOT CONNECTED with circulation offers elsewhere in this magazine.



**YES!** Please rush me a copy of the 1986 Jaycar Engineering Catalogue.

Name: \_\_\_\_\_

Address: \_\_\_\_\_

Postcode: \_\_\_\_\_

**POST TO:**  
**JAYCAR ELECTRONICS**  
P.O. BOX 185,  
CONCORD NSW 2137

**YES!** Please also enter my subscription for 12 issues of Electronics Australia (postage paid) for the unbelievably low price of \$22.

Name and address as shown to left.

- ☐ I enclose cheque/money order for \$22  
☐ Please debit  
Bankcard/Mastercard/Visa/American Express

--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

Offer valid until May 31, 1986.

(Please make cheques payable to Federal Publishing Company).



critical situations due to physical layout being highlighted and corrected.

The software then analyses the selected design without regard to the specifications, to find out what the actual performance will be and ensures that this meets or exceeds the customer's requirements. Finally, suitable acceptance test routines are developed for use when the device is in production.

It is encouraging to find that although CAD software contains all known design rules for laying out a chip, it is often possible for a skilled engineer to intervene and further improve the chip utilisation or performance. This technique is called 'massaging' a design and

gives meaning to the term 'hand crafted' which is often used to describe full custom ICs.

AWA have complete semiconductor production facilities on the same site as the Design Centre in North Ryde. They claim this minimises delays due to communication problems between design and manufacturing and as a consequence can provide a customer with prototype ICs within four weeks of a design being finalised.

Until recently, the major semiconductor technology for VLSI devices was NMOS but increasing use is now being made of CMOS. Bipolar is also available for analog applications and CMOS

and bipolar can be mixed on the same chip if required.

Some interesting applications for AWA custom ICs include medically implanted cardiac pacemakers and bone growth simulators, hearing aids, telephone switching, data modems, security systems, Barra anti submarine sonobuoys and a military calculator.

Fully custom ICs suffer from the slow and costly CAD/CAM design sequence and this excludes them from low volume applications where time and cost are critical. For really high volume applications and for specific areas where ultimate performance is required they have no equal.

## Bipolar IC technology

Most integrated circuits utilise either bipolar or unipolar technology. A few combine both technologies on the same chip. In bipolar systems, the active elements are forms of junction transistors.

Transistor transistor logic (TTL) is probably the best known bipolar technology. Originally introduced in the early 1960's it has developed through many phases. With standard TTL, the switching transistors operate in either a saturated or cut off mode. Storage effects in saturated transistors caused standard TTL to be rather slow for some applications, so a range of ICs with minimum value collector and emitter resistors was introduced. These devices were known as high speed TTL. The use of low value resistors increased current consumption and heat dissipation became a problem as larger more densely packed chips were developed.

Where speed was not important, high value resistors could be used, giving reduced power consumption. This resulted in a range of devices known as low power TTL.

Many present day TTL products incorporate Schottky diodes which have a forward voltage drop about half that of a silicon junction. If a diode of this type is connected across the collector/base junction of a bipolar transistor, as shown in Fig. 2(a), it will be non-conducting when the junction is in its normal reverse biased state. If the base

current rises sufficiently to saturate the transistor, the collector voltage falls below the base voltage and the Schottky diode starts to conduct. Diode conduction occurs long before the collector voltage can fall sufficiently to forward bias the collector/bias junction and transistor saturation is prevented.

Schottky diodes are easily built into the collector/base junction when a bipolar transistor is fabricated on a silicon slice as shown in Fig. 2(b). A wide range of devices incorporating various forms of Schottky technology are available under names such as Schottky-clamped TTL, Low Power Schottky TTL, Advanced Schottky TTL and Advanced Low Power Schottky TTL.

Another form of bipolar technology avoids the problems associated with saturation by using transistors biased to operate in their mid conduction region.

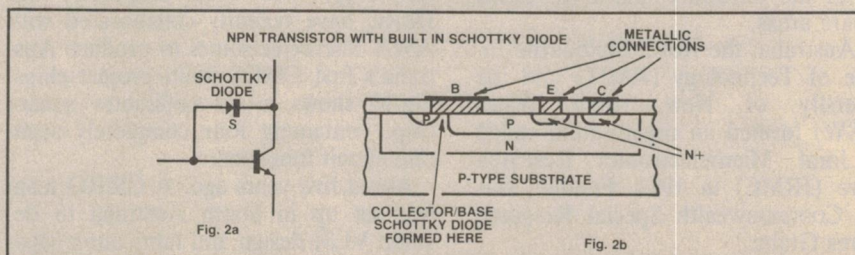
Logic signal inputs are applied to groups of transistors which share a common emitter resistor. When one transistor turns on, it takes the common emitter line high which

biases the others off. Current is thus steered from one transistor to another and the total current taken by the circuit remains roughly constant and well below any one transistor's saturation level. This technology is called emitter-coupled logic (ECL) and variations include buffered ECL and emitter-emitter logic (E<sup>2</sup>L).

ECL provides some of the fastest operating speeds obtainable but does have quite high power consumption. Its main application is in medium and large computers.

A third major bipolar technology is called integrated injection logic (I<sup>2</sup>L) or sometimes merged transistor logic (MTL). Here the output transistor's load is incorporated in the input of the following gate, so that unused output collector circuits do not have unnecessary current flowing through them. The low power consumption of I<sup>2</sup>L/MTL makes it particularly suitable for LSI and VLSI applications.

Recent variations of I<sup>2</sup>L/MTL include Integrated Schottky Logic (ISL) and Schottky Transistor Logic (STL), etc.





## Future trends

There seems to be almost complete agreement within the microelectronics industry that ASICs will be the major growth product over the next 10 or 15 years. This trend may be accentuated in Australia because locally designed equipment normally has a low production volume and we have seen that field and mask programmable devices can be ideal in this situation. Opinions differ on the speed with which ASICs will replace 'off the shelf' ICs, but estimates of a 50% market share by the year 2000 are not unusual.

There is also general agreement that CMOS will become the mainstream technology for both 'off the shelf' and ASICs over the next few years. Some experts predict that 80% of devices produced by the end of this decade will be CMOS. Device geometries of one mi-

**This is a multi-project chip developed by the Joint Microelectronic Research Centre. Four independent circuit functions are incorporated on the 6mm square chip.**

## Local R & D

Most of the world's large microelectronic companies have their own well equipped research and development departments to ensure that products retain a competitive position in the market place. Despite this heavy-weight presence however, there is still ample opportunity for smaller organisations and individuals to come up with innovative ideas or ingenious solutions to problems in both the hardware and CAD/CAM software areas.

In Australia, the Royal Melbourne Institute of Technology (RMIT) and the University of New South Wales (UNSW) formed an organisation called the Joint Microelectronics Research Centre (JMRC) in 1982. Funding was by a Commonwealth Special Research Centres Grant.

Work on semiconductor materials and processing at JMRC has included investigation of ion implantation and annealing, plasma etching, gallium arsenide fabrication problems, etc. On the software side, JMRC have developed advanced CAD techniques with applications in the gate array, standard cell, multi project chip and custom VLSI areas. It is hoped that some of this new software will be marketed commercially during 1986.

Multi-project chips, produced at the centre, provide a very economical way of fabricating prototype ICs, as 10 or 15 totally different designs can be incorporated on a single silicon wafer. NMOS technology was used originally, but JMRC have recently collaborated with AWA Microelectronics to produce Australia's first CMOS multi project chips. Fig.10 shows a six millimetre square chip, containing four completely separate circuit functions.

About five years ago, A CSIRO team was set up in South Australia to develop VLSI design and fabrication capa-

bilities. This work culminated in the successful production of a chip containing the equivalent of over 100,000 transistors.

Following on from this success, a commercial company called Austek Microsystems was established in Adelaide. Funding was provided by the AIDC and private investors in the US, UK and Australia. The company now also has offices in California and Singapore.

Austek's main efforts are concentrated on developing a range of high performance VLSI devices for specialised applications in the computing area. These include high performance arithmetic chips, application and specific memories and co-processors.

In addition to standard products, Austek also undertakes full custom design work for individual clients. Recent projects have included a 50,000 transistor correlator chip for the CSIRO's new radio telescope, a high speed image processing IC for Vision Systems Ltd and a sophisticated 2 micron logic chip for a US computer company.



cron are promised for the end of 1986 and this will further increase operating speed, reduce chip size and power dissipation and improve production yield. Bipolar technologies such as ECL are expected to survive into the next century, but their applications will become increasingly specialised.

Fig.11 compares standard logic and the various ASIC technologies in six areas of particular interest to potential users. The figures given are based on an amalgum of information from many sources and are not representative of any one supplier.

From the users' viewpoint, there are still some problems to be solved before ASICs can be regarded as ideal devices.

Procurement times of three to four months for standard cell ICs and perhaps over a year for full custom devices are not always acceptable in a fast moving and competitive industry. Overseas suppliers may always be at a disadvantage in this respect and it is good to see increasing interest in the provision of local design and fabrication facilities.

## Cross-licensing

An equipment manufacturer is often reluctant to 'put all his eggs in one basket' and depend upon a single supplier for key components such as ICs. This is because a strike, major fire or financial

collapse at the manufacturer's plant, over which the user has no control, could stop production and put him out of business. The solution is to second source all critical components, but this is not easy with ASICs, due to variations in technology between suppliers and the confidentiality of designs. Tentative moves towards cross licensing have already been made by some manufacturers, but broader second sourcing arrangements are required before major users in fields such as consumer goods or automotive electronics become completely happy with the new technology.

The development of bigger and better ICs over the past 20 years has resulted in packages having more and more lead out pins. The photograph on page 76 shows a selection of current in-line, pin-grid and chip carrier packages to illustrate the point. Connections are one of the few remaining causes of poor reliability in modern electronic equipment and efforts are usually made to minimise their number. Custom design can offer a solution to this problem, as we shall see in a moment.

The growth of production and interest in ASICs could not have occurred without associated improvements in CAD/CAM systems. Software for PC and mainframe applications is now becoming more readily available, cheaper and easier to use. This trend seems set to

continue and work stations may soon be a normal part of almost every electronic design lab. If sophisticated workstations are widely provided, it could help reduce the procurement time problem mentioned earlier.

The IC industry expects all areas of ASIC technology to expand, but many experts believe standard cell technology will be the major growth area. They also predict that the boundary between library cell and full custom design will become increasingly blurred, with the possibility of the two technologies merging in a few years time. The spread of workstation facilities would obviously encourage these trends.

The standard cell library approach has been likened to a system designer selecting devices from a data book and then planning the layout of a printed circuit board to support and inter-connect them. For many future applications, the designer can expect to put a complete system on a single chip. This avoids the need for complex inter-connections with other sections of circuitry and helps solve the IC pin problem mentioned above.

It seems that in some equipment, the familiar PCB with its separate ICs and discrete components may soon be disappearing, to be replaced by a single ASIC package, plus power supply.  $\text{\textcircled{A}}$

Fig.11. COMPARISON OF STANDARD LOGIC AND DIFFERENT ASIC TYPES

	Standard logic families	Field programmable logic arrays	Gate arrays	Standard cells	Fully custom
Semiconductor technology	All types	Mainly bipolar	TTL, ECL, NMOS, CMOS	Mainly CMOS	Some NMOS but becoming mainly CMOS
IC design expertise required	None	Minimal	Moderate	Moderate/High	High
Typical development/procurement time	Immediate	Hours	4/8 weeks	3/4 months	3/18 months
Minimum/maximum quantity	Not applicable	5/1000	50/10,000	50/50,000	5000 (special applications)/one million plus
Sources	Many	Several	Usually only one	One or two	One
Equivalent 2 input gate size	4/40	150/5000	350/10,000	500/10,000	Up to 25,000

## ACKNOWLEDGEMENTS:

The author wishes to thank the following companies for their generous assistance and material supplied during the preparation of this article.

*Austek Microsystems Pty. Ltd., Adelaide.*

*AWA Microelectronics Division, Sydney.*

*Ferranti Computer Systems (Australia) Pty. Ltd., Sydney.*

*Hardie Technologies NSD, Melbourne. (Representing National Semiconductor Corp., USA).*

*Joint Microelectronics Research Centre, University of New South Wales, Sydney.*

*Motorola Semiconductor Products, Sydney.*

*Philips Electronic Components and Materials (Philips/Signetics), Sydney.*

*R and D Electronics, Melbourne. (Representing Advanced Micro Devices, General Electric, Intersil, Monolithic Memories, Silicon Systems, all of the USA).*

*Texas Instruments Australia Ltd., Sydney.*



# COMPARE BEFORE

OUR PRICES

YOU BUY



Dear Customer, Over the last 9 years we at Altronics have toiled away often into the night with one major goal in mind — to provide you with competitively priced quality components and products with a superior standard of service. Looking back in 1986, I guess you could say the 10's of thousands of Shop and Mail Order Customers served, stand testament to our endeavours. We have resisted the "high powered advice" from Advertising firms to churn out the expensive colour brochures and the like as eventually this must add to the cost of our products and unnecessarily waste your hard earned cash. (Even today of our products and Catalogues are produced "in house" at a fraction of the cost otherwise). The secret to our phenomenal growth we believe must lay, apart from our extremely conscientious attitude to service and delivery, in our policy of employing **Electronic Enthusiasts**. Just like yourself, in virtually every section of Altronics, so remember when you want a little technical advice — help is as close as your phone. Then of course there is the matter of our low prices!

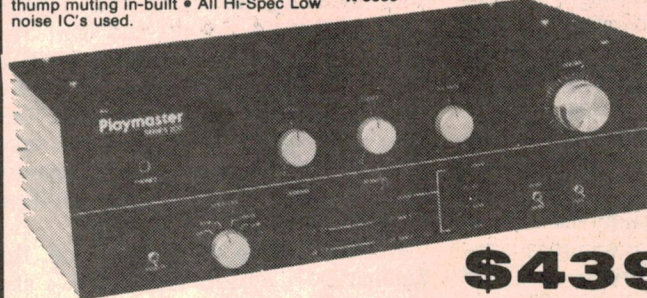


Jack O'Donnell

## Series 200 Mosfet Integrated Amplifier Ultra Fidelity

**Features:** - This brilliantly designed stereo amplifier will equal or better just about any integrated commercial amp regardless of price. It is a no-compromise design capable of delivering 100 watts per channel at very low distortion. Four basic stereo inputs are provided for both moving magnet and moving coil cartridges. Also three high level stereo inputs are provided for compact disc players, AM/FM tuner and auxiliary input which could be from a stereo TV tuner or Hi Fi VCR. Input facilities are also provided for two stereo cassette decks and full monitoring facilities are available for either deck plus dubbing from Deck 1 to Deck 2 or vice versa. Full CMOS Analog switching (soft touch). Twist Type Speaker lead binding posts supplied. De-thump muting in-built. All Hi-Spec Low noise IC's used.

- Incredibly accurate RIAA equalisation
  - No control wiring whatsoever
  - Led indication of switch status (on/off)
  - All components mount on the PCB, even pots and sockets
  - Super efficient Toroidal Transformer—Low Hum
  - Uses Hitachi Mosfet Power devices
  - In-Built over drive protection
  - Centre detents on Bass, Treble and Balance Controls
  - Multiple detents on volume control
  - Heavy Duty Heatsinks.
- Specifications:—**  
**Power Output:** 100W RMS into 8 Ohms (per channel) **Freq. Response:** 8Hz to 20KHz +0 -0.3db 2.8Hz to 65KHz +0 -1db **Input Sensitivity:** 0.775mV for full power Hum: -100db below full output **S/N Ratio:** 94db flat -100db A-weighted **Distortion:** 0.01% @ 1KHz **Stability:** Unconditional  
**K 5030**



**\$439**

## Check Appliances and Electrical Wiring Megohm Meter

(1985 Successor to the "Megger")

It uses a transistor inverter to produce a regulated 1000V DC supply which is applied to the insulation under test. Insulation resistances between 2M Ohm and more than 2000 Ohm can be measured.  
**K 2550** (See EA July '85)



**\$49.95**

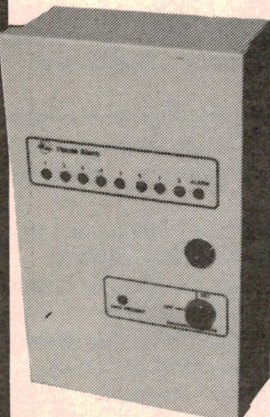
## Super Low Price on Famous EA 8 Sector Alarm System Kit

(See EA Mag. Jan '85)

**\$119.50**

### Features:

- Alarm has 8 separate input circuits - 8 sectors can be monitored independently.
- Each input circuit is provided with an indicator LED and a sector On/Off switch.
- Individual sector isolation allows the user to have some areas of the premises habited while others remain protected e.g. Inside Off/Outside On.
- Inputs accept both normally closed and normally open sensors.
- Two inputs provided with an entry delay between 10-75 seconds).
- Internal trip warning buzzer—alerts owner/occupant of pending alarm operation—great for the "forgetful" amongst us. This buzzer is pre-settable between 5 and 55 seconds prior to Alarm.
- Unique circuit detects automatically when any N/O or N/C loops are either open circuit or dead short. e.g. someone trying to bridge reed switches etc.
- Switched output can be used to send a silent alarm through an auto-dialler circuit or similar.

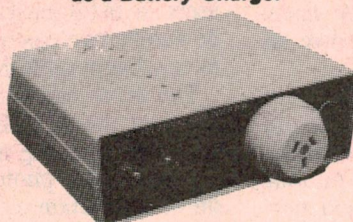


**K 1900** (without Back Up Battery) **\$119.50**  
**S 5065** (12V 1.2AH Backup Battery) **\$22.95**



## Build These Great Kits and Save \$\$\$

### 12/240V Inverter for Small Appliances Low Power Design also Works as a Battery Charger



The inverter is ideally suited to powering low wattage mains appliances from the car battery while camping. This considerably improves the comfort level of the civilised camper. Similarly, it has uses in boating. Typically, it can be used to power an electric shaver, electric blanket, electric can opener or a 40W light bulb. Alternatively, back in the home (or still on the camp site). Frequency sensitive items such as belt or idler driven turntables can be powered at a very precise crystal controlled frequency for accurate sound reproduction. If speed variation over a small range is required, then a switch is provided to change from the crystal based 50Hz signal to a variable oscillator. **K 6705**

**\$69.50**

### 300 Watt Inverter 240V Mains Power From your 12V Battery

(See EA Sept. '85)

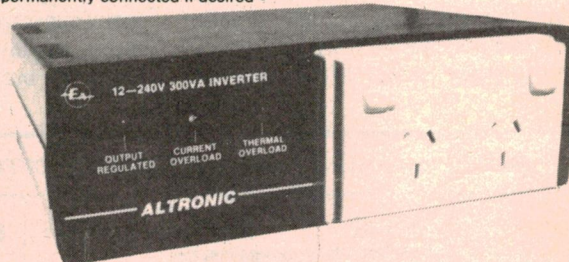
Just think how handy it would be to have 240Volt AC Mains Power when camping, or for your Boat or Caravan—well this brilliant new design from Leo Simpson and the Design Team at Electronics Australia is the answer.

- **Super Compact** - kit supplied in Altronics H 0482 Tough "ABS" Case.
- **Uses High Efficiency Toroid Transformer** thus keeping down heat dissipation, battery drain and weight.
- **Auto Start** draws power from your battery only when appliance is plugged in and "turned on" i.e. battery can be left permanently connected if desired.

### with Auto Start

**Thermal Over Load** automatically shuts down if/when output stage is overheated (through high ambient temperature and high load or combination thereof — Automatic reset • **Current Regulated** Indicates inverter is being used within designed load limits • **Current Overload** unit self limits — LED indicates overload conditions. Single P.C. board construction — easy to build as there is very little internal wiring.

**Complete Kit K 6752 \$199**  
**Fully Built and Tested K 6754 \$269**



### Laboratory Power Supply 3 - 50 Volt at Up to 5 Amps

Designed by Electronics Australia, this supply has been one of our most popular throughout 1985. Our superb 1986 version incorporates the latest refinements and is now housed in an attractive, tough "ABS" Instrument case. This all new compact version has been made possible by the use of a high efficiency Toroid Power Transformer.

So you win four ways - Less heat, less weight - Greatly enhanced appearance and easier to build - **Remember the Altronics Kit is fully drilled and punched.**

**Brilliant Switch Mode High efficiency design by the Design Team at Electronics Australia.**

### 10 Turn Output Voltage Control Option

(K 3300 is normally supplied with standard pot)

**K 3301 \$12.50**

### Auxiliary + And -12V Output Terminals Option

(Fixed Outputs Independent of Variable Main Output)

**K 3302 \$12.50**



**\$149.50 K 3300**



## Make Your Next Party Swing With The Fantastic Musicolour IV

Ideal for Parties, Shop Signs, Display Windows, special lighting effects etc. Combination Colour Organ and Light Chaser. Four channel colour organ. Internal microphone or connect to speakers for colour organ operation. (The lights connected to each channel pulse in beat to the music proportional to portion of frequency spectrum concerned). Four chaser modes forward and reverse. Output lamp load capacity a massive 2400 watts — that's 100 party globes. Full instructions and every last nut and bolt included. Great for parties, shop signs, display windows etc. K 5800

**\$99**



## Stereo Enhancer

Widen your Stereo Image

This fantastic circuit increases the difference between the two channels thus actually making music sound "Wider". Therefore the stereo effect can be perceived although speakers are relatively close together.

This unit is self contained including power supply and enhancement metering. K 5405

**\$89.50**

## Car Security System The Ultimate in Vehicle Protection

Uses Microphone Sensing to Guard Against Tampering and Vandalism. The latest 'State of the Art' Vehicle Security System. This ETI design provides protection that could save you a fortune. Strategically placed resonance microphones detect any tampering with your vehicle e.g. Lifting of a door handle, scratching of a coin etc.

## Ultrasonic Pest Repeller

Build EA's new "Pest-Off" and save a small fortune on insect sprays.

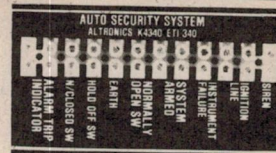
The "Pest-Off" generates frequencies between 23KHz and 64KHz. Claimed to be the best for driving off most vermin.

Altronics Kit Includes • Strong "ABS" Case • Efficient Piezo Tweeter • Screened Front Panel. K 1600

**\$39.95**



- Auto Arming with Exit and Entry delays
- Dash Mount status indicator
- Remove Protection of bolt-on accessories
- Inc. circuitry to monitor any failure of dash warning lights.
- Normally closed and normally open circuits available.
- Supplied in high quality "ABS" Case with drilled and screened front panel.
- Protect your expensive stereo — Simply run a wire from the alarm system normally closed terminal to any earth screw on your stereo.



K 4340 ..... **\$59.50**



105 STIRLING STREET, PERTH  
**FOR INSTANT SERVICE  
PHONE ORDER  
TOLL FREE  
008 999 007**

**PERTH METRO  
AND AFTER HOURS  
ORDERING SERVICE**  
(09) 328 1599

**ALL MAIL ORDERS**

Box 8280, Stirling St. Perth W.A. 6000

**PACKING AND  
DELIVERY CHARGES**

**\$3.00 DELIVERY AUSTRALIA WIDE**

We process your order the day received and despatch via. Australia Post. Allow approx. 7 days from day you post order to when you receive goods. Weight limited 1Kg.

**\$6.00 OVERNIGHT JETSERVICE** We process your order the day received and despatch via. overnight jetservice Courier for delivery next day. Country areas please allow additional 24-48 hours. Weight limit 3Kgs.

**\$6.00 HEAVY MAIL SERVICE** For deliveries exceeding 3Kgs and less than 10Kgs - allow 7 days for delivery

**\$10.00 HEAVY HEAVY SERVICE** - All orders of 10Kgs. or more must travel Express Road - Please allow 7 days for delivery.

**INSURANCE** — As with virtually every other Australian supplier, we send goods at consignee risk. Should you require comprehensive insurance cover against loss or damage please add 1% order value (Minimum charge \$1). When phone ordering please request "Insurance".

**TOLL FREE PHONE ORDER** - Bankcard Holders can phone order toll free up to 6pm Eastern Standard Time. Remember with our **Overnight Jetservice** we deliver next day.

## Altronics Resellers

Chances are there is an Altronics Reseller right near you — check this list or phone us for details of the nearest dealer.

**Blue Ribbon Dealers** are highlighted with a ■. These dealers, generally carry a comprehensive range of Altronics products and kits or will order any required item for you.

**Don't forget our Express Mail and Phone Order Service** — for the cost of a local call, Bankcard, Visa or Mastercard holders can phone order for same day despatch.

**Please Note:** Resellers have to pay the cost of freight and insurance and therefore the prices charged by individual dealers may vary slightly from this Catalogue — in many cases, however, Dealer prices will still represent a significant cost saving from prices charged by Altronics Competitors.

**WA**  
**COUNTRY**  
**ALBANY**  
BP  
Electronics ■ ... 41 2681  
**ESPERANCE**  
Esperance  
Communications 71 3344  
**GERALDTON**  
K.B. Electronics  
& Marine ..... 21 2176  
**KALGOORLIE**  
Todays  
Electronics ■ ... 21 2777  
**WYALKATCHEM**  
D & J Pease ..... 81 1132

**NT**  
**DARWIN**  
Ventronics ..... 81 3491  
**ALICE SPRINGS**  
Ascom  
Electronics ..... 52 1713  
Farmer  
Electronics ..... 52 2967

**ACT**  
**CITY**  
Bennett Commercial  
Electronics ..... 80 5359  
Scientronics ..... 54 8334

**SA**  
**CITY**  
Electronic  
Comp & Equip. 212 5999  
Force  
Electronic ■ ... 212 2672  
Protronics ..... 2123111  
**SUBURBAN**  
**BRIGHTON**  
Brighton  
Electronics ■ ... 296 3531  
**CHRISTIES BEACH**  
Force  
Electronics ■ ... 382 3366  
**PROSPECT**  
Jensen  
Electronics ■ ... 269 4744  
**REYNELLA**  
Force  
Electronics ■ ... 381 2824  
**COUNTRY**  
**MT. GAMBIER**  
South East  
Electronics ..... 250 034  
**PT. LINCOLN**  
West Coast  
Elect. Supplies ..... 82 5802  
**WHYALLA**  
Eyre  
Electronics ■ ... 45 4764  
**TAS**  
**HOBART**  
D & I Electrical  
Electronics ..... 34 8244  
George Harvey ■ ... 342233  
**LAUNCESTON**  
George Harvey ■ 31 6533  
**LEGANA**  
Frank Beech  
Electronics ..... 301379

**VICTORIA**  
**CITY**  
Active  
Electronics ■ ... 602 3499  
All Electronic  
Components ..... 662 3506  
MaGraths  
Electronics ..... 347 1122  
**SUBURBAN**  
**BENTLEIGH**  
Absolute  
Electronics ..... 557 3971  
**BOX HILL SOUTH**  
Eastern  
Communications 288 3107  
**CHELTENHAM**  
Talking  
Electronics ..... 550 2386  
**CROYDEN**  
Truscott  
Electronics ■ ... 723 3860  
**PRESTON**  
Preston  
Electronics ..... 48 40191  
**SPRINGVALE**  
Active  
Electronics ■ ... 547 1046  
**COUNTRY**  
**BENDIGO**  
KCJohnson ■ ... 41 1411  
**MORWELL**  
Morwell  
Electronics ..... 34 6133  
**SHEPPARTON**  
GV Electronics ■ 21 8866  
**SWAN HILL**  
Cornish Radio  
Services ..... 32 1427

**QUEENSLAND**  
**CITY**  
Delsound P/L .. 2296155  
Jaycar ..... 393 0777  
**SUBURBAN**  
**FORTITUDE VALLEY**  
McGraths  
Electronics ..... 832 3944  
Economic  
Electronics ..... 523 762  
**PADDINGTON**  
Jacques  
Electronics ..... 369 8594  
**SLACKS CREEK**  
David Hall  
Electronics ..... 2088808  
**TOOWONG**  
Techniparts ..... 3710879  
**COUNTRY**  
**CAIRNS**  
Thompson Instrument  
Services ..... 512404  
**BUNDEBERG**  
Bob Elkins  
Electronics ..... 721 785  
**MACKAY**  
Philtrons ■ ... 578855  
**NAMBOUR**  
Nambour  
Electronics ..... 411604  
**PALM BEACH**  
The Electronic  
Centre ..... 341248  
**ROCKHAMPTON**  
Electron  
World ..... 278 988  
Purely Electronics  
(East St.) ..... 21058  
Purely Electronics  
(Shopping Fair) 280 100

**TOOWOOMBA**  
Hunts  
Electronics ■ ... 329677  
**TOWNSVILLE**  
Solex ■ ... 722015  
**NSW**  
**CITY**  
David Reid  
Electronics ■ ... 267 1385  
Jaycar ..... 267 1614  
**SUBURBAN**  
**CARLINGFORD**  
Jaycar ..... 872 4444  
**CONCORD**  
Jaycar ..... 745 3077  
**GORE HILL**  
Jaycar ..... 439 4799  
**HURSTVILLE**  
Jaycar ..... 570 7000  
**LEWISHAM**  
PrePak  
Electronics ..... 569 9770  
**COUNTRY**  
**ALBURY**  
Webb's  
Electronics ■ ... 25 4066  
**BATHURST**  
The Electronics  
Shop ..... 31 4421  
**BROKEN HILL**  
Crystal TV ..... 4803  
**COFFS HARBOUR**  
Coffs Harbour  
Electronics ..... 52 5684

**GOSFORD**  
Tomorrows  
Electronics ■ ... 24 7246  
**KURRI KURRI**  
Kurri Electronics 37 2141  
**NEWCASTLE**  
D.G.E. Systems ..... 69 1625  
George Brown &  
Company ..... 69 6399  
**NOWRA**  
Southern  
Communications 21 4011  
**ORANGE**  
Fyfe  
Electronics ..... 626 491  
**RAYMOND TERRACE**  
Alback  
Electronics ..... 87 3419  
**RICHMOND**  
Vector  
Electronics ..... 773 174  
**TENTERFIELD**  
Nathan Ross ..... 36 2204  
**TOUKLEY**  
TES Electronics . 96 4144  
**WINDSOR**  
M & E Electronics ■  
Communications 77 5935  
**WOLLONGONG**  
Newtek  
Electronics ■ ... 27 1620  
Madjen  
Electronics ..... 74 3061  
Vimcom  
Electronics ..... 28 4400

## More Altronics Dealers Wanted

If you have a Retail Shop, you could increase your income significantly by becoming an Altronics Dealer. Phone Steve Wroblewski 09 381 7233 for Details.



# CD ROM —

## high density computer storage

*That little silver CD platter which has revolutionised home audio is now set to do the same for home and business computer information storage. CD-ROM, the (almost) twin brother of the hifi audio compact disc, has now appeared in Australia.*

by STEWART FIST

The storage of computerised reference data — dictionaries, encyclopaedias, technical and scientific research papers — is where CD-ROM's impact will initially be but it is also likely to eventually revolutionise the distribution of computer programs, from video games to business application programs.

Just as computers proved to be a universal information manipulating machine with applications that now pervade all phases of modern life, CD will likely become the universal information storage medium. You need large-scale storage to complement the faster computer technologies; without this storage the potential of the chips are limited.

CD-ROM is not a new invention so much as the logical extension of audio CD, and both are digital derivatives of the video LaserDisc developed by Philips many years ago. You may believe that videodisc is long dead as a consumer technology, but LaserDisc is still being sold for video information systems, technical training and education, and for videogames.

The problem with videodisc was that it replayed video only, so it failed to push recording magnetic tape out of the living rooms of the world. But the lack of the ability to record hasn't limited the technology's application in hi-fi audio, and it should prove to be only a partial limitation with computers and data.

From the time when LaserDisc first appeared in the late '70s, it has been apparent to many that the technology offered a phenomenal packing density for storing information of all sorts. On a standard 30cm LaserDisc you can find between 54,000 and 90,000 frames of full-colour video with accompanying sound. The difference in frame numbers depends on whether you spin the LaserDisc turntable at a constant speed (CAV or Constant Angular Velocity), or whether you slow it down when the laser-head is tracing the periphery of the disc (CLV or Constant Linear Velocity) and therefore pack in more images.

The LaserDisc used a frequency modulation technique to handle analog video signals, and although it is generally accepted that you need about one million bytes of binary information to reproduce a good quality colour video screen, you can't just do a straight mathematical conversion and assume that the LaserDisc has the potential to store 90,000 million bytes (90 gigabytes) of ASCII-coded data.

In practice it has been found that the analog LaserDisc can hold about 5 gigabytes — which is impressive enough — and in fact one English company called Laser Data actually produces a LaserDisc with this data storage capacity.

But generally it was found that the videodisc suffered too high an error rate for it to be useful for computer program storage. A glitch in video replay just puts a spot on the TV screen, but a glitch in a computer program or data could send a company bankrupt.

The audio Compact Disc took the manufacturing, reading and tracking technology from LaserDisc, but used digital techniques and much smaller (12cm) discs. It also has too high an



Sony have three CD-ROM drives with a capacity of 540 megabytes. Also available are interface cards for the IBM PC/XT.





Developed in the UK, this "electronic book" system can store up to 600 megabytes of information in any combination of text, pictures, graphics, sound or software. It is based on the Philips version of the CD-ROM.

error rate for direct use as a computer storage device, although it is acceptable for text where an occasional misspelled word doesn't matter.

So Philips and Sony put their heads together over the development of the CD-ROM. This required higher mechanical and electrical standards, and included better error-checking circuits to overcome the data-integrity problems. CD-ROM has an error rate of one in  $10^{12}$ , which is only one error in every million million bytes read.

But Sony and Philips weren't alone in seeing the potential of the basic CD digital audio technology for computer applications. A number of computer companies in the US banded together to work on a rival device they called O-ROM (Optical Read-Only-Memory) which has still to appear on the market.

To date, these companies still haven't managed to agree on more than the basic standards for O-ROM, so it is unlikely to be a serious competitor for CD-ROM in the next couple of years. And there are a number of good marketing reasons why it might not appear at all.

CD-ROM is downwardly compatible with the CD audio; both use spiral tracks which start at the disc centre and extend outwards. In both cases the turntable speed varies from 230rpm to 530rpm to maintain a constant head-to-disc reading speed; the Constant Linear Velocity (CLV) technique.

### Large capacity

CLV maximises the amount of information that the discs can store — 8.4 blocks (each of 2 Kbytes) per rotation on the inner tracks, and 19.5 blocks/rev on the outer — which makes the 12cm discs capable of storing 540 megabytes.

That's about 54 times the average hard-disc, 540 times the best of the double-sided floppies, or 2-3000 times most single-sided floppy discs. In paper terms, it is the equivalent of 150,000 pages of printed text — a pile of A4 paper about 15 metres high — or a complete set of a large encyclopaedia!

The O-ROM developers are taking a different line which reveals their computer orientation. They opted for circular, rather than spiral tracks, since they were not worried by the need to remain compatible with CD audio players. They also chose to keep the turntable speed constant (CAV at about 500rpm) in order to improve the access time. With CLV technology you are always waiting for the mechanical turntable to speed up or slow down before the appropriate data can be read.

### Faster access

The value of using CAV over CLV is apparent when you compare the access and transfer rates of the two systems. CD-ROM is slower in finding information when it jumps tracks and it can transfer data at only 150 kilobytes per

second. O-ROM is quick in finding data and nearly triples the CD transfer rate at 400 Kb/s.

O-ROM is not all that much slower at transferring data than many magnetic hard-discs — which was obviously a major reason why the computer group chose the CAV approach. But there's always a trade-off; the use of a fixed angular speed means that the O-ROM disc will hold only 200 megabytes of information as against the 540 Mb of CD-ROM. The rotational speed must be chosen to suit the most inefficient track.

The battle between the two rival systems is not likely to be won on technical grounds, but on market-place considerations and here CD-ROM has a clear lead. It has already been standardised, and the standard is widely accepted. Companies like National, Hitachi and Denon have joined Philips and Sony in manufacturing disc players, and many other computer groups (like Digital Equipment Corp.) have signed agreements to sell versions of the players under their own brand names.

The main marketing advantage of CD-ROM, however, must arise from the fact that it is compatible with CD-audio. Both Philips and Sony expect to have dual-purpose ROM/audio players on the market within the year, and the inclusion of short bursts of full-colour video won't be too far down the track.

There's also the fact that CD-ROM is using the tried and tested mechanical



# CD ROM

and optical systems of LaserDisc and CD-audio. These are already in production and have been through the problem phases of development and early consumer use. Sony are already promoting a player (the CDU-5002) which they claim will have a mean-time-between-failures of 10,000 hours.

For these reasons CD-ROM should be considerably cheaper and probably more reliable than O-ROM, and the "CD" name will have that vital factor of consumer confidence. It is a pretty hard combination to beat — and anyone who bets against the combined marketing power of Sony and Philips better have a vastly superior product.

CD-ROM players in the States are expected to sell for between \$US300 and \$US1000, which will translate to at least twice this amount in Australian dollars. The discs themselves will be priced according to the value of information they contain, rather than being related to production costs.

A new automated disc factory in the UK is said to be able to replicate CD discs for £3 (three English pounds) each, not counting the cost of the mastering process. On average it costs about \$5,000 to produce the master 'stamper' from a correctly formatted half-inch computer master tape.

On the software side there are already a number of companies well advanced in producing the information for discs — although CD-ROM has raised new and unexpected problems in copyright and its effect on competitive services.

A number of the major on-line database suppliers (Dialog, Orbit, BRS, Compuserve and The Source) have already signalled that their data will be available on discs this year, but some see the CD-ROM as a major threat to their services. Some are attempting to test out the marketplace without putting more than a toe into the water, and some can't decide whether CD-ROM is just a replacement for the on-line technology, or something quite new and different in the marketplace.

The Commonwealth Agricultural Bureaux, for instance, which is a UK clearing house for agricultural information, has already moved over part of its activities into CD-ROM. CAB abstracts nearly a quarter of a million articles and agricultural reports each year from magazines, journals and research papers all over the world, and it costs about

\$70 to \$100 per hour (all up) to search through this information on-line from your computer in Australia.

By contrast one CD-ROM disc can now hold a full year of CAB abstracts, and the disc also carries the BASIS program that your computer needs to search the special varied inverted indexes of keywords. These inverted indexes traditionally occupy almost as much disc space as the original abstracts themselves if the full-text of each abstract has been indexed for easy searching.

At present CAB have priced their CD-ROM service at \$5000 for a two-year subscription, with the discs updated and exchanged monthly — so it is aimed at libraries and agricultural research establishments only. The pricing level has obviously been chosen to prevent competition with their on-line database, and it bears no relationship to the cost of production of the discs themselves.

It would be a fair guess to say that CAB don't want to pioneer the use of home computers and CD-ROM players by the millions of farmers around the world, but this must be a future possibility. When it does happen the cost per subscription will probably drop to the \$100 to \$200 level.

## Encyclopaedia

Groliers of New York have already taken this more innovative marketing approach, by producing a consumer CD product. They have translated the 21 volumes of their Grolier's Academic American Encyclopaedia to one single disc, and priced the disc at \$US199 — less than half the price of their paper volumes.

The 21-volume encyclopaedia already sells for \$450, which is reasonable considering that there's probably nearly \$100 worth of paper alone in these, plus the printing, transport, storage and retailing costs. It is here, in the provision of home and business references, that the value of CD is most readily apparent.

Grolier's disc only holds about nine million words, plus a 155,000 word index and the searching program. You can find the information you are seeking in either a "browse" or "word-matching" mode. "Browse" gives you a wide range of related topics around your subject of interest, while "word-

match" uses a key-word search procedure which selects out all articles containing the word you specified.

The disc-based program takes, on average, about five seconds to find any subject, and is claimed to work with most of the popular brands of micro-computers.

At present the Grolier's encyclopaedia only holds words, so there is plenty of room later for computer graphics and illustrations. The company says that it is working on this and may be able to add sound and music in relevant sections at a later stage.

These 'multi-media' developments aren't entirely new or confined to the ROM version of CD. It is not generally known that the normal CD audio system includes additional storage space that can be used for text or graphic information — for example, the words of a song, or supporting graphics and animation. The information is read-out by the player, and with the right machine it can be displayed on an in-built LCD screen or via a linked monitor.

## CD map system

There is an electronic map and guidance system for your car called CD-Carin which combines sound, text and graphics capabilities to store the information normally found in conventional maps and guide books.

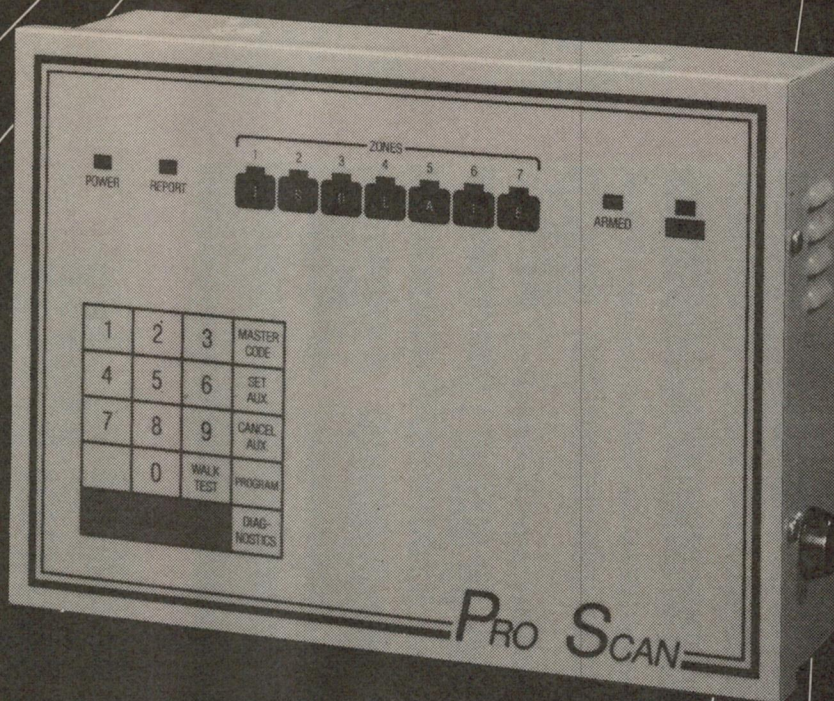
You can selectively access all kinds of route, location or touristic information. The computer is able to plan the most efficient route across a city, telling you where to turn at every road junction through a speech synthesiser.

The trial unit already on the road in Holland also picks up data about traffic flow, broadcasts in HF so the driver can avoid traffic jams. Philips plan eventually to link Carin with the American Navstar satellite to provide totally accurate navigation plots.

It's not hard to see that the whole spectrum of relatively 'static' reference information that we use — encyclopaedias, dictionaries, histories, biographies, medical references, legal precedents, scientific research abstracts, patents, technical, scientific and medical journals, telephone directories, and a thousand and one other more specialised publications can all be transferred to CD with a minimum of problems, and made available usually at considerably less cost than the paper version.

Whichever way you look at it, the CD-ROM looks like being another big success for the CD format. E





Computer Microprocessor Australia,  
Unit 6D, 23-25 Windsor Road,  
North Mead, NSW. 2152.

# PROSCAN

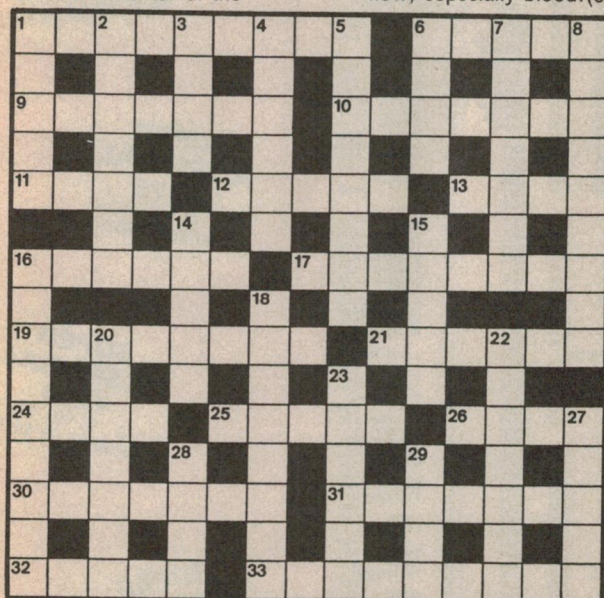
THE PROFESSIONALS' CHOICE IN SECURITY EQUIPMENT  
TELEPHONE: (02) 630-8700 TELEX: 177503 PATLAS

For supplies of Electronic  
Components and design and  
development of Electronic  
equipment contact:

## MAY CROSSWORD

### DOWN

1. Former fanciful medium. (5)
2. Parts of headphones. (7)
3. Form of air traffic. (4)
4. Ozone. (6)
5. Joint inventor of the bipolar transistor. (8)
6. First in, first out. (4)
7. Role of car speaker! (7)
8. Instrument that measures speed of fluid flow, especially blood. (9)

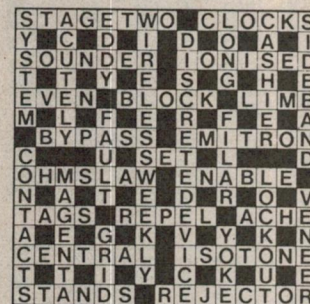


14. Degree of signal strength. (5)
15. Name of a signalling lamp. (5)
16. Device that alters an electronic parameter. (9)
18. Restore battery potential. (8)
20. Region on a graph indicating constant output. (7)
22. Utter data for recording. (7)
23. Automotive system usually checked electronically. (6)
27. Game with computer application. (5)
28. Threaded rod. (4)
29. Property of electron. (4)

### ACROSS

1. Elementary particles. (9)
6. Control unit. (6)
9. Type of oscillator. (7)
10. Said of computer, etc, with limited access. (3-4)
11. Obtain computer data. (4)
12. Moves to next channel. (5)
13. Prefix to "ware" in computer jargon. (4)

## SOLUTION FOR APRIL



16. Electronic device. (6)
17. Possible LED output. (3-5)
19. Two-channel system. (8)
21. This provides tight security for your EA magazines! (6)
24. Pot-like device. (1-3)
25. Said of a component with a linear resistive characteristic. (5)
26. Possible label for a current mode switch. (2-2)
30. Kind of speaker. (7)
31. Term indicating coherence. (2-5)
32. Golfer's circuit. (5)
33. Graduates. (9)



# SUPER IC SPECIAL 2732

1-9 10-99 100+  
\$6.25 \$5.95 \$5.50

# SUPER IC SPECIAL AM 7910

WORLD MODEM CHIP  
\$29.50

# SUPER IC SPECIAL 4164

1-9 10-99 100+  
\$2.95 \$2.75 \$2.50

# SUPER IC SPECIAL 6116LP-3

1-9 10-99 100+  
\$3.95 \$3.75 \$3.50

# 30% OFF THESE PRICES!

During May, we  
are offering the  
following semi's at  
30% off our  
normal prices!  
...but be quick!!

4001	4020	4069	4516
4002	4023	4071	4518
4011	4025	4072	4520
4012	4026	4073	4526
4013	4030	4081	45105
4014	4020	4093	40175
4015	4043	4161	40014
4016	4047	4194	45112
4017	4049	4503	6802
4018	4051	4510	6821
4019	4066	4511	6850

U21630 Z80ASIO ADC0804LCN  
U21720 F9001DC FD1791(8876)  
XR8038

# SUPER IC SPECIAL 27256

1-9 10-99 100+  
\$11.50 \$10.00 \$9.00

# SUPER IC SPECIAL 41256

1-9 10-99 100+  
\$6.95 \$6.50 \$5.50

# SUPER IC SPECIAL 27128

1-9 10-99 100+  
\$7.00 \$6.50 \$6.25

# SUPER IC SPECIAL 6264

1-9 10-99 100+  
\$6.50 \$5.50 \$5.25

# SUPER IC SPECIAL 6802

1-9 10-99 100+  
\$5.00 \$4.75 \$4.50

ICL7106 19.50	74C374 4.45	74LS324 2.20	LM377 4.90	BD238 1.90	2N3055 1.00	6AMP 1.00	8271 89.00	HLMP6620 3.95	4056 4.20
ICL7116 19.50	74C3901 3.00	74LS327 2.20	LM378 3.95	BD262 1.90	2N3096 1.20	BPFC02 2.90	8272 33.00	LEDS 2.50	4060 2.50
ICL7117 21.50	74C3902 2.50	74LS327 2.20	LM380 8 pin 1.80	BD283 1.20	2N3109 1.90	KBPC604 3.50	8273 65.00	3mm RED .25	4063 2.00
ICL7611 6.95	74C3903 2.50	74LS352 2.20	LM380 8 pin 1.80	BD437 1.50	2N3251 1.90	KBPC608 4.50	8274 42.50	3mm YELL. 30	4066 4.50
ICM7211 12.50	74C3904 1.50	74LS333 2.20	LM382 3.50	BD488 1.50	2N3252 1.90	KBPC610 4.50	8275 38.50	3mm YELL. 30	4067 8.50
ICM7216A 18.50	74C3905 15.00	74LS354 3.95	LM383 1.90	BD647 1.80	2N3440 1.90	KBPC1002 4.20	8276 28.50	5mm RED .15	4069 1.00
ICM7216B 18.50	74C3906 2.90	74LS356 1.00	LM381 3.50	BD648 1.80	2N3441 2.90	KBPC1004 4.90	8279 8.50	5mm YELL. 30	4070 1.00
ICM7216B 18.50	74C3907 2.90	74LS357 1.00	LM382 3.50	BD677 1.80	2N3442 3.50	KBPC3502 5.90	8283 6.50	5mm ONG 30	4071 .40
ICM7224A 44.50	74C3910 14.00	74LS368 1.00	LM384 3.50	BD682 2.00	2N3564 3.00	KBPC35014MD	8284 8.50	RED RECT. 30	4072 .90
ICM7224A 44.50	74C3911 12.50	74LS373 1.90	LM385 3.50	BDV648 3.90	2N3565 3.00	KBPC35014MD	8286 6.50	GRN RECT. 30	4073 .90
ICM7226A 21.50	74C3914 4.50	74LS375 1.90	LM387A 3.95	BDV658 3.90	2N3566 3.00	KBPC35014MD	8287 6.50	YEL RECT. 30	4075 .90
ICM7226A 21.50	74C3915 4.00	74LS377 2.15	LM387 3.95	BDV658 3.90	2N3567 3.00	KBPC35014MD	8289 73.00	RED CHROME	4076 1.50
ICM7227A 18.50	74C3916 4.00	74LS377 2.15	LM391 2.90	Y96 (BUX) 80	2N3568 3.00	KBPC35014MD	8291 57.50	BEZEL 1.20	4077 .80
ICM7227A 18.50	74C3918 2.90	74LS379 1.90	LM393 1.90	BDY97 (BUX) 80	2N3569 3.00	KBPC35014MD	8292 57.50	CHROME	4078 .80
ICM7227A 18.50	74C3920 12.50	74LS386 1.00	LM395 2.90	BDY97 (BUX) 80	2N3570 3.00	KBPC35014MD	8293 57.50	CHROME	4079 .80
ICM7227A 18.50	74C3921 12.50	74LS386 1.00	LM396 2.90	BDY97 (BUX) 80	2N3571 3.00	KBPC35014MD	8294 57.50	CHROME	4080 .80
ICM7227A 18.50	74C3922 12.50	74LS393 1.80	LM398 2.90	BDY97 (BUX) 80	2N3572 3.00	KBPC35014MD	8295 57.50	CHROME	4081 .80
ICM7227A 18.50	74C3923 12.50	74LS395 2.50	LM399 2.90	BDY97 (BUX) 80	2N3573 3.00	KBPC35014MD	8296 57.50	CHROME	4082 .80
ICM7227A 18.50	74C3924 12.50	74LS395 2.50	LM400 2.90	BDY97 (BUX) 80	2N3574 3.00	KBPC35014MD	8297 57.50	CHROME	4083 .80
ICM7227A 18.50	74C3925 12.50	74LS395 2.50	LM401 2.90	BDY97 (BUX) 80	2N3575 3.00	KBPC35014MD	8298 57.50	CHROME	4084 .80
ICM7227A 18.50	74C3926 12.50	74LS395 2.50	LM402 2.90	BDY97 (BUX) 80	2N3576 3.00	KBPC35014MD	8299 57.50	CHROME	4085 .80
ICM7227A 18.50	74C3927 12.50	74LS395 2.50	LM403 2.90	BDY97 (BUX) 80	2N3577 3.00	KBPC35014MD	8300 57.50	CHROME	4086 .80
ICM7227A 18.50	74C3928 12.50	74LS395 2.50	LM404 2.90	BDY97 (BUX) 80	2N3578 3.00	KBPC35014MD	8301 57.50	CHROME	4087 .80
ICM7227A 18.50	74C3929 12.50	74LS395 2.50	LM405 2.90	BDY97 (BUX) 80	2N3579 3.00	KBPC35014MD	8302 57.50	CHROME	4088 .80
ICM7227A 18.50	74C3930 12.50	74LS395 2.50	LM406 2.90	BDY97 (BUX) 80	2N3580 3.00	KBPC35014MD	8303 57.50	CHROME	4089 .80
ICM7227A 18.50	74C3931 12.50	74LS395 2.50	LM407 2.90	BDY97 (BUX) 80	2N3581 3.00	KBPC35014MD	8304 57.50	CHROME	4090 .80
ICM7227A 18.50	74C3932 12.50	74LS395 2.50	LM408 2.90	BDY97 (BUX) 80	2N3582 3.00	KBPC35014MD	8305 57.50	CHROME	4091 .80
ICM7227A 18.50	74C3933 12.50	74LS395 2.50	LM409 2.90	BDY97 (BUX) 80	2N3583 3.00	KBPC35014MD	8306 57.50	CHROME	4092 .80
ICM7227A 18.50	74C3934 12.50	74LS395 2.50	LM410 2.90	BDY97 (BUX) 80	2N3584 3.00	KBPC35014MD	8307 57.50	CHROME	4093 .80
ICM7227A 18.50	74C3935 12.50	74LS395 2.50	LM411 2.90	BDY97 (BUX) 80	2N3585 3.00	KBPC35014MD	8308 57.50	CHROME	4094 .80
ICM7227A 18.50	74C3936 12.50	74LS395 2.50	LM412 2.90	BDY97 (BUX) 80	2N3586 3.00	KBPC35014MD	8309 57.50	CHROME	4095 .80
ICM7227A 18.50	74C3937 12.50	74LS395 2.50	LM413 2.90	BDY97 (BUX) 80	2N3587 3.00	KBPC35014MD	8310 57.50	CHROME	4096 .80
ICM7227A 18.50	74C3938 12.50	74LS395 2.50	LM414 2.90	BDY97 (BUX) 80	2N3588 3.00	KBPC35014MD	8311 57.50	CHROME	4097 .80
ICM7227A 18.50	74C3939 12.50	74LS395 2.50	LM415 2.90	BDY97 (BUX) 80	2N3589 3.00	KBPC35014MD	8312 57.50	CHROME	4098 .80
ICM7227A 18.50	74C3940 12.50	74LS395 2.50	LM416 2.90	BDY97 (BUX) 80	2N3590 3.00	KBPC35014MD	8313 57.50	CHROME	4099 .80
ICM7227A 18.50	74C3941 12.50	74LS395 2.50	LM417 2.90	BDY97 (BUX) 80	2N3591 3.00	KBPC35014MD	8314 57.50	CHROME	4100 .80
ICM7227A 18.50	74C3942 12.50	74LS395 2.50	LM418 2.90	BDY97 (BUX) 80	2N3592 3.00	KBPC35014MD	8315 57.50	CHROME	4101 .80
ICM7227A 18.50	74C3943 12.50	74LS395 2.50	LM419 2.90	BDY97 (BUX) 80	2N3593 3.00	KBPC35014MD	8316 57.50	CHROME	4102 .80
ICM7227A 18.50	74C3944 12.50	74LS395 2.50	LM420 2.90	BDY97 (BUX) 80	2N3594 3.00	KBPC35014MD	8317 57.50	CHROME	4103 .80
ICM7227A 18.50	74C3945 12.50	74LS395 2.50	LM421 2.90	BDY97 (BUX) 80	2N3595 3.00	KBPC35014MD	8318 57.50	CHROME	4104 .80
ICM7227A 18.50	74C3946 12.50	74LS395 2.50	LM422 2.90	BDY97 (BUX) 80	2N3596 3.00	KBPC35014MD	8319 57.50	CHROME	4105 .80
ICM7227A 18.50	74C3947 12.50	74LS395 2.50	LM423 2.90	BDY97 (BUX) 80	2N3597 3.00	KBPC35014MD	8320 57.50	CHROME	4106 .80
ICM7227A 18.50	74C3948 12.50	74LS395 2.50	LM424 2.90	BDY97 (BUX) 80	2N3598 3.00	KBPC35014MD	8321 57.50	CHROME	4107 .80
ICM7227A 18.50	74C3949 12.50	74LS395 2.50	LM425 2.90	BDY97 (BUX) 80	2N3599 3.00	KBPC35014MD	8322 57.50	CHROME	4108 .80
ICM7227A 18.50	74C3950 12.50	74LS395 2.50	LM426 2.90	BDY97 (BUX) 80	2N3600 3.00	KBPC35014MD	8323 57.50	CHROME	4109 .80
ICM7227A 18.50	74C3951 12.50	74LS395 2.50	LM427 2.90	BDY97 (BUX) 80	2N3601 3.00	KBPC35014MD	8324 57.50	CHROME	4110 .80
ICM7227A 18.50	74C3952 12.50	74LS395 2.50	LM428 2.90	BDY97 (BUX) 80	2N3602 3.00	KBPC35014MD	8325 57.50	CHROME	4111 .80
ICM7227A 18.50	74C3953 12.50	74LS395 2.50	LM429 2.90	BDY97 (BUX) 80	2N3603 3.00	KBPC35014MD	8326 57.50	CHROME	4112 .80
ICM7227A 18.50	74C3954 12.50	74LS395 2.50	LM430 2.90	BDY97 (BUX) 80	2N3604 3.00	KBPC35014MD	8327 57.50	CHROME	4113 .80
ICM7227A 18.50	74C3955 12.50	74LS395 2.50	LM431 2.90	BDY97 (BUX) 80	2N3605 3.00	KBPC35014MD	8328 57.50	CHROME	4114 .80
ICM7227A 18.50	74C3956 12.50	74LS395 2.50	LM432 2.90	BDY97 (BUX) 80	2N3606 3.00	KBPC35014MD	8329 57.50	CHROME	4115 .80
ICM7227A 18.50	74C3957 12.50	74LS395 2.50	LM433 2.90	BDY97 (BUX) 80	2N3607 3.00	KBPC35014MD	8330 57.50	CHROME	4116 .80
ICM7227A 18.50	74C3958 12.50	74LS395 2.50	LM434 2.90	BDY97 (BUX) 80	2N3608 3.00	KBPC35014MD	8331 57.50	CHROME	4117 .80
ICM7227A 18.50	74C3959 12.50	74LS395 2.50	LM435 2.90	BDY97 (BUX) 80	2N3609 3.00	KBPC35014MD	8332 57.50	CHROME	4118 .80
ICM7227A 18.50	74C3960 12.50	74LS395 2.50	LM436 2.90	BDY97 (BUX) 80	2N3610 3.00	KBPC35014MD	8333 57.50	CHROME	4119 .80
ICM7227A 18.50	74C3961 12.50	74LS395 2.50	LM437 2.90	BDY97 (BUX) 80	2N3611 3.00	KBPC35014MD	8334 57.50	CHROME	4120 .80
ICM7227A 18.50	74C3962 12.50	74LS395 2.50	LM438 2.90	BDY97 (BUX) 80	2N3612 3.00	KBPC35014MD	8335 57.50	CHROME	4121 .80
ICM7227A 18.50	74C3963 12.50	74LS395 2.50	LM439 2.90	BDY97 (BUX) 80	2N3613 3.00	KBPC35014MD	8336 57.50	CHROME	4122 .80
ICM7227A 18.50	74C3964 12.50	74LS395 2.50	LM440 2.90	BDY97 (BUX) 80	2N3614 3.00	KBPC35014MD	8337 57.50	CHROME	4123 .80
ICM7227A 18.50	74C3965 12.50	74LS395 2.50	LM441 2.90	BDY97 (BUX) 80	2N3615 3.00	KBPC35014MD	8338 57.50	CHROME	4124 .80
ICM7227A 18.50	74C3966 12.50	74LS395 2.50	LM442 2.90	BDY97 (BUX) 80	2N3616 3.00	KBPC35014MD	8339 57.50	CHROME	4125 .80
ICM7227A 18.50	74C3967 12.50	74LS395 2.50	LM443 2.90	BDY97 (BUX) 80	2N3617 3.00	KBPC35014MD	8340 57.50	CHROME	4126 .80
ICM7227A 18.50	74C3968 12.50	74LS395 2.50	LM444 2.90	BDY97 (BUX) 80	2N3618 3.00	KBPC35014MD	8341 57.50	CHROME	4127 .80
ICM7227A 18.50	74C3969 12.50	74LS395 2.50	LM445 2.90	BDY97 (BUX) 80	2N3619 3.00	KBPC35014MD	8342 57.50	CHROME	4128 .80
ICM7227A 18.50	74C3970 12.50	74LS395 2.50	LM446 2.90	BDY97 (BUX) 80	2N3620 3.00	KBPC35014MD	8343 57.50	CHROME	4129 .80
ICM7227A 18.50	74C3971 12.50	74LS395 2.50	LM447 2.90	BDY97 (BUX) 80	2N3621 3.00	KBPC35014MD	8344 57.50	CHROME	4130 .80
ICM7227A 18.50	74C3972 12.50	74LS395 2.50	LM448 2.90	BDY97 (BUX) 80	2N3622 3.00	KBPC35014MD	8345 57.50	CHROME	4131 .80
ICM7227A 18.50	74C3973 12.50	74LS395 2.50	LM449 2.90	BDY97 (BUX) 80	2N3623 3.00	KBPC35014MD	8346 57.50	CHROME	4132 .80
ICM7227A 18.50	74C3974 12.50	74LS395 2.50	LM450 2.90	BDY97 (BUX) 80	2N3624 3.00	KBPC35014MD	8347 57.50	CHROME	4133 .80
ICM7227A 18.50	74C3975 12.50	74LS395 2.50	LM451 2.90	BDY97 (BUX) 80	2N3625 3.00	KBPC35014MD	8348 57.50	CHROME	4134 .80
ICM7227A 18.50	74C3976 12.50	74LS395 2.50	LM452 2.90	BDY97 (BUX) 80	2N3626 3.00	KBPC35014MD	8349 57.50	CHROME	4135 .80
ICM7227A 18.50	74C3977 12.50	74LS395 2.50	LM453 2.90	BDY97 (BUX) 80	2N3627 3.00	KBPC35014MD	8350 57.50	CHROME	4136 .80
ICM7227A 18.50	74C3978 12.50	74LS395 2.50	LM454 2.90	BDY97 (BUX) 80	2N3628 3.00	KBPC35014MD	8351 57.50	CHROME	4137 .80
ICM7227A 18.50	74C3979 12.50	74LS395 2.50	LM455 2.90	BDY97 (BUX) 80	2N3629 3.00	KBPC35014MD	8352 57.50	CHROME	4138 .80
ICM7227A 18.50	74C3980 12.50	74LS395 2.50	LM456 2.90	BDY97 (BUX) 80	2N3630 3.00	KBPC35014MD	8353 57.50	CHROME	4139 .80
ICM7227A 18.50	74C3981 12.50	74LS395 2.50	LM457 2.90	BDY97 (BUX) 80	2N3631 3.00	KBPC35014MD	8354 57.50	CHROME	4140 .80
ICM7227A 18.50	74C3982 12.50	74LS395 2.50	LM458 2.90	BDY97 (BUX) 80	2N3632 3.00	KBPC35014MD	8355 57.50	CHROME	4141 .80
ICM7227A 18.50	74C3983 12.50	74LS395 2.50	LM459 2.90	BDY97 (BUX) 80	2N3633 3.00	KBPC35014MD	8356 57.50	CHROME	4142 .80
ICM7227A 18.50	74C3984 12.50	74LS395 2.50	LM460 2.90	BDY97 (BUX) 80	2N3634 3.00	KBPC35014MD	8357 57.50	CHROME	4143 .80
ICM7227A 18.50	74C3985 12.50	74LS395 2.50	LM461 2.90	BDY97 (BUX) 80	2N3635 3.00	KBPC35014MD	8358 57.50	CHROME	4144 .80
ICM7227A 18.50	74C3986 12.50	74LS395 2.50	LM462 2.90						





## 12-240V DC-AC INVERTER INCLUDING 300 WATTS TRANSFORMER

This inverter is capable of driving mains appliances rated up to 300VA and features voltage regulation and full over load protection.  
(EA June '82) 821V6  
Nominal Supply: Voltage 12V DC  
Output: Voltage see table  
Frequency: 50Hz  $\pm$  0.05%  
Regulation: see table  
Maximum Load: 300VA  
Current Limiting: 30A (primary)  
Efficiency: see table

Relative Load Watts	Output Voltage (RMS)	Input Current (A)	Efficiency (%)	Battery life 40Ah/20h Rate (minutes)
0	210	1.2	0	0
40	235	4.5	60	240
100	240	11.3	62	80
140	240	15.0	69	60
200	240	20.1	78	50
240	240	24.0	79	32
300	235	29.6	82	28

P&P \$10.00 Anywhere in Australia  
Cat. K82062 Normally \$219  
Now on special at \$195

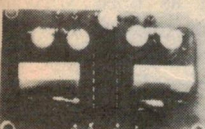


## TRANSISTOR TESTER

Have you ever desoldered a suspect transistor, only to find that it checks OK? Trouble-shooting exercises are often hindered by this type of false alarm, but many of them could be avoided with an "in-circuit" component tester, such as the EA Handy Tester. (EA Sept. '83) 83TT8  
Cat. K83080 Normally \$18.95  
SPECIAL, ONLY \$14.95

## OP AMP TESTER

The Op Amp Tester which could save you hours in agonising whether that old op amp that's been sitting in the draw for the last year.  
(ETI April '85) 851183  
Cat. K41830 \$26.95



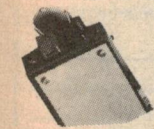
## GENERAL PURPOSE AMPLIFIER CLASS B

One of the handiest 'tools' for the electronics experimenter is a genuine purpose audio amp. This module will work from a wide range of supply voltages, has good sensitivity, is robust and reliable - easy to build too! (ETI 453)  
(ETI April '80)  
Cat. K44530 \$14.95



## RAILMASTER PULSE POWER TRAIN CONTROLLER

Here's an up-to-the-minute train controller offering all the most desirable features including inertia, full overload protection, walk-around throttle and excellent long-speed running characters. Probably the best controller available, regardless of the cost!  
(EA Sept. '84) 84TC9  
Cat. K84091 \$79.50



## ZENER TESTER

A simple low cost add-on for your multimeter. This checks zeners and reads out the zener voltage directly on your multimeter. It can also check LEDs and ordinary diodes.  
(ETI May '83) ETI 164  
Cat. K41640 \$11.95

# KIT SPECIALS!



## 300W "BRUTE" AMPLIFIER

The "Brute" develops 300W into 4 ohms, 200W into 8 ohms!  
For many audio applications there's no substitute for sheer power - low efficiency speakers, outdoor sound systems, or maybe you like the full flavour of the dynamic range afforded by a high power amp. Whatever your requirement - this 'super power' module should fill the bill. (ETI 466) (ETI Feb '80)  
Cat. K44660 Normally \$89.95  
SPECIAL, ONLY \$79.95  
(Heatsink not included)

## TRANSFORMER TO SUIT (PF4363)

Cat. M21110 \$79.95



## 30V/1A FULLY PROTECTED POWER SUPPLY

The last power supply we did was the phenomenally popular ETI-131. This low cost supply features full protection, output variation from 0V to 30V and selectable current limit. Both voltage and current metering is provided. (ETI Dec. '83) ETI 162  
Cat. K41620 Normally \$54.50  
\$47.50



## DUAL TRACKING POWER SUPPLY

Built around positive and negative 3-Terminal Regulators, this versatile dual tracking Power Supply can provide voltages up to 2A. In addition the Supply features a fixed +5V 0.9A output and is completely protected against short circuits, overloads and thermal runaway.  
(EA March '82) 82PS2  
Cat. K82030 Normally \$109  
SPECIAL, ONLY \$99



## EA AM STEREO DECODER

AM stereo is now broadcast in Australia on an experimental basis. This add-on decoder works with the Motorola C-QUAM system.  
(EA Oct. '84) 84MS10  
Cat. K84100 Normally \$26.95  
SPECIAL, ONLY \$20.95



## ELECTRIC FENCE

Mains or battery powered, this electric fence controller is both inexpensive and versatile. Based on an automotive ignition coil, it should prove an adequate deterrent to all manner of livestock. Additionally, its operation conforms to the relevant clauses of Australian Std 3129. (EA Sept. '82) 82EF9  
Cat. K82092 Normally \$19.95  
SPECIAL, ONLY \$14.95

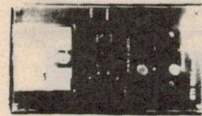
## PLAYMASTER 300 WATT AMPLIFIER

This module will deliver up to 200 watts into an 8 ohm load and up to 300 watts into a 4 ohm load. Comprehensive protection is included and a printer circuit board brings it all together in a rugged easy-to-build module. It can be built in either fully-complementary or quasi-complementary versions, so output transistor shortages should be no problem at all.  
(80PA6) (EA July '80)  
Cat. K80060 Normally \$109  
SPECIAL, ONLY \$99



## ELECTRONIC MOUSETRAP

This clever electronic mousetrap disposes of mice instantly and mercifully, without fail, and resets itself automatically. They'll never get away with the cheese again!  
(ETI Aug. '84) ETI 1524  
Cat. K55240 \$34.95



## LOW OHMS METER

How many times have you cursed your Multimeter when you had to measure a low-value resistance? Well with the "Low Ohms Meter" you can solve those old problems and in fact measure resistance from 100 Ohms down to 0.005 Ohms.  
(ETI Nov. '81) ETI 158  
Cat. K41580 \$39.50

## EXPANDED SCALE VEHICLE AMMETER

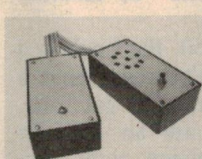
This "electronic ammeter" can be installed without disturbing the vehicles existing wiring, will operate on 12V or 24V systems and features an easy to read scale indicating charge and discharge currents up to 45 Amps.  
(ETI 329 ETI Feb '81)  
Cat. K43290 \$29.95

## GENERAL PURPOSE PREAMPLIFIER

A general purpose stereo preamplifier using a single LM382 IC which can be tailored for use with magnetic pickups, tape recorders or microphones by changing a few components. (ETI 445) (ETI July '76)  
Cat. K44490 \$9.95

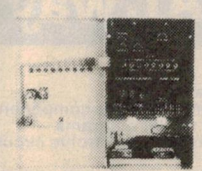
## TELEPHONE EXTENDER

This simple project allows you to leave the phone unattended as you move about the your home or garden.  
(ETI 547, June '77)  
Cat. K45470 \$29.95



## PICTURE PLUCKER FACSIMILE DECODER

Print your own weather maps with your Microbee. This project allows you to decode the signals of shortwave stations transmitting "radio facsimile" weather maps and satellite pictures and then reproduce them on your dot-matrix printer.  
(ETI 736, ETI Sept '83)  
Cat. K47360 \$29.95



## MULTI SECTOR ALARM STATION

Protect your home and possessions from burglars with this up to the minute burglar alarm system. It's easy to build, costs less than equivalent commercial units, and features eight separate inputs, individual sector control, battery back up and self-test facility.  
Specifications:  
• Eight sectors with LED status indication.  
• Two delayed entry sectors.  
• Variable exit, entry and alarm time settings: entry delay variable between 10 and 75 seconds; exit delay variable between 5 and 45 seconds; alarm time variable between 1 and 15 minutes.  
• Resistive loop sensing: suits both normally open and normally closed alarm sensors.  
• Battery back-up with in-built charger circuit.  
• Built-in siren driver.  
Complete kit including deluxe prepunched metal work and electronics for only...

Cat. K85900 \$129

## NOW IN STOCK! SELECTED

# AEM KITS!

## AEM ULTRA FIDELITY PREAMP

Now in stock! This superb preamp includes: the case, components, prepunched front panel etc. There's nothing else to buy.  
(AEM 8010, Oct/Nov '85)  
Cat. K90000 \$269

## LISTENING POST (AEM 3500)

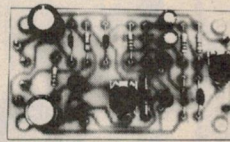
Cat. K93015 \$37.95

## AEM DUAL SPEED MODEM

The ultimate kit modem featuring 1200/300 baud, case etc. Exceptional value for money!  
(AEM 4600 Dec '85)  
\$169

## STROBE KIT

Includes perspex cover!  
(AEM 9500)  
Cat. K93018 \$59.95



## 1W AUDIO AMPLIFIER

A low-cost general-purpose, 1 watt audio amplifier, suitable for increasing your computers audio level, etc. (EA Nov. '84)  
Cat. K84111 \$9.95



## MICROBEE ENHANCER 1

This amazing kit for the Microbee is a must for all Microbee owners! Most expansion units up to this time offered at best only one or two features; and this made it impossible to run, for example, complex sound effects mingled with speech. The Enhancer 1 will do all this and much more as well. It is quite amazing how much has been shoe-horned into this compact unit.  
The Enhancer 1's many powerful features include...

- Two ATARI/COMMODORE/COLECO/SEARS type joystick inputs.
- Two TRS COLOUR COMPUTER type joystick inputs.
- Allows the connection of Touch Pads, Paddies, Proportional Joysticks, Trakballs, Mice, temperature sensors, lights level sensors, transducers, etc, etc!
- A 4 voice music/sound effects synthesizer.
- A real time clock.
- Unlimited vocabulary speech synthesizer (option).
- Parallel printer interface (option).
- A built-in speaker with volume control.
- Listings of all necessary routines for use.
- An impressive demonstration program package.
- Compatible to all Microbees.
- Digital recording and playback of speech and sound.
- An 8 channel analog to digital converter with variable voltage or variable resistance type analog inputs and also user selectable resolution from 1 to 9 bits.
- A digital to analog converter with selectable resolution from 1-8 bits.
- Allows automatic data acquisition and logging.
- 5 digital input lines, 4 digital output lines.
- A voice input channel.
- A 40 pin experimenter socket with all 8 analog inputs, 5 digital inputs, 4 digital outputs, 3.58 MHz buffered clock, sound output (so that you can play the sound effects through your HI FI), 3 high resolution voltage comparators, DAC output etc.

The amazing Microbee Enhancer is available exclusively from Rod Irving Electronics.  
\$149

# LATEST KITS AT ROD IRVING ELECTRONICS



## DIGITAL SAMPLER KIT

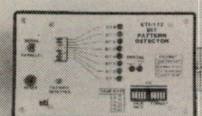
Digital sampling is at the core of many of the special sound effects used by modern musicians. A trigger input (usually a construction drum pad) triggers a prerecorded sound from the digital sampler. This sound has been recorded into the 4K of onboard memory and can be digitally manipulated so that it sounds completely different on playback. The unit has controls for gain, regeneration and mixing. It also gives a choice of a number of different triggering methods.  
(ETI 1402 May, June, July '86)  
Cat. K41420

Please phone for price and availability

## ELECTROSTATIC HAZARD DETECTOR KIT

It's called electrostatic hazard and if it, or even its baby brother, jumps on the back of your IC or transistor, then the poor device is never likely to be quite the same again. So, out of a very ordinary collection of bits and pieces, ETI has fashioned a black box that will sit quietly on a corner of your bench for years at a time and beep when ever high tension appears. It may save you a lot of trouble, particularly if you ever work with CMOS. (ETI 173 May '86)  
Cat. K41720

Please phone for price and availability



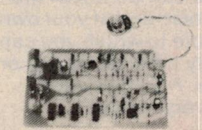
## BIT PATTERN GENERATOR KIT

In applications where you are required to look for a particular byte of information in a serial or parallel data path, short of a logic analyser or a storage oscilloscope, there is not a lot to help you. However, this Bit Pattern Generator gives you a simple and economical way to detect and display specific bytes of data. It may be used on both parallel and serial data paths.  
(ETI 172, May '86)  
Cat. K41720

Please phone for price and availability

## "HANDS FREE" OR LOUDSPEAKER TELEPHONE ADATOR

This attractive desktop unit enables "Hands Free" two way conversation over the telephone. The advantages of being able to engage in a telephone conversation with both hands free to take notes, look up information, perform calculations or to operate a computer keyboard are both obvious and desirable. Now you can enjoy all the benefits for less than \$80!  
(EA Nov. '85)  
Cat. K86030 \$79

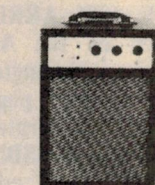


## VIDEO FADER CIRCUIT

Add a touch of professionalism to your video movies with this simple Video Fader Circuit. It enables you to fade a scene to black (and back again) without loss of picture lock (sync) or colour.  
(EA Jan '86, 85H10)  
Cat. K86010 \$19.95

## PLAYMASTER FM/AM STEREO TUNER

The new Playmaster FM/AM stereo tuner will out perform anything presently available on the market, regardless of price. As well as including a FM tuner section which is every bit as good as any other synthesised design, it is also the only unit featuring a genuine wideband, low distortion AM stereo tuner. Naturally, it has a digital readout, 12 station memory, automatic seek and an optional infrared remote control.  
(EA Dec. '85 Jan-Feb '86 85tu12)  
Cat. K86020 \$399



## THE BUSKER PORTABLE AMPLIFIER

This handy amplifier is completely portable and is capable of operating from either the mains or a 12V battery. Main features include guitar and high-level inputs, an inbuilt loudspeaker, and bass and treble controls. It's just the thing for busking or for guitar practice.  
(EA Feb. '85 85ba2)  
Cat. K85020 (excluding cabinet) \$99



## ELECTRIC FENCE CONTROLLER

Restore discipline to the farm or allotment with this new electric fence controller. It features higher output power and lower current drain than the previous design for use in rural areas.  
(EA Dec. '85, 85ef11)  
Cat. K85110 \$44.95



## ROD IRVING ELECTRONICS

425 High Street, Northcote, 3070  
VICTORIA, AUSTRALIA  
Phone (03) 489 8866  
48 A Beckett St, MELBOURNE, 3000  
VICTORIA, AUSTRALIA  
Ph. (03) 663 6151  
Mail Order and correspondence:  
P.O. Box 620, CLAYTON 3168  
TELEX: AA 151938



## MAIL ORDER HOTLINE (03) 543 7877 (2 lines)

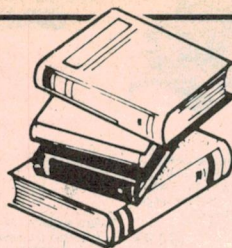
POSTAGE RATES  
\$1-\$9.99 \$2.00  
\$10-\$24.99 \$3.00  
\$25-\$49.99 \$4.00  
\$50-\$99.99 \$5.00  
\$100-\$199 \$7.50  
\$200-\$499 \$10.00  
\$500 plus \$12.50  
This is for basic postage only. Comet Road freight, bulky and fragile items will be charged at different rates.  
Certified Post for orders over \$100 included "free"  
Registered Post for orders over \$200 included "free"  
All sales tax exempt orders and wholesale inquiries to RITRONICS  
WHOLESALE, 56 Renner Rd. Clayton  
Phone (03) 543 2166



Errors and Omissions Excepted.



# Books & Literature



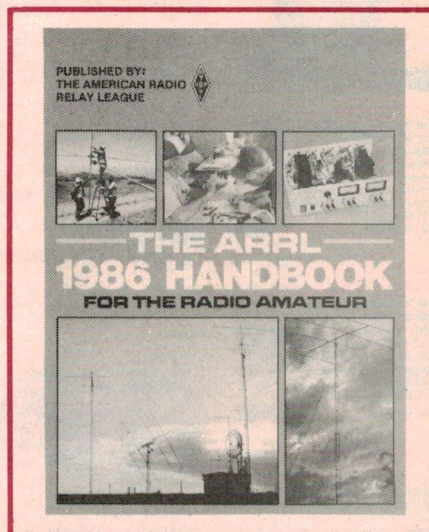
## Massive new amateur radio handbook

**THE 1986 ARRL HANDBOOK.** Published by the American Radio Relay League, Newington, Connecticut. Soft covers, 700 pages (approx), 276 x 207mm. Illustrated with diagrams and photographs. ISBN 0-87259-063-1.

This latest edition of the ARRL Handbook is truly impressive. Those familiar with issues past will agree that it was a most useful publication, full of useful information to electronic enthusiasts in general and amateur radio operators in particular. If there was any criticism of past issues it could be that they, of necessity, repeated a good number of previously published chapters.

For 1986 though, the ARRL has done itself proud. The new edition is much larger than 1985 and has a considerable number of completely new chapters. There are also quite a few new electronic projects to build and printed circuit board patterns are included. Naturally, these projects mostly pertain to amateur radio but some of them, such as power supplies, are of interest to electronic enthusiasts generally.

All told, there are 40 chapters which are broken up into six sections: Intro-



duction, Radio Principles, Modulation Methods, Transmission, Construction and Maintenance and On the Air. The first four sections are largely devoted to electronic theory while the last two are on the "nuts and bolts" of amateur radio.

At the price of \$39.50, the book is a bargain and if you don't already have a previous copy you should get one, whether or not you are an amateur radio operator. Our review copy came from Dick Smith Electronics. (C.R.D.)

## Industry reference on process control

**PROCESS INSTRUMENTS AND CONTROLS HANDBOOK, THIRD EDITION:** by Douglas M. Considine. Published 1985 by McGraw-Hill Book Company, USA. Hard covers, 230 x 162mm, 1766 pages, illustrated with diagrams, tables and photographs. ISBN 0-07-012436-1. Recommended retail price \$183.95.

The last Process Instruments and Controls Handbook was published in 1974. In the ensuing 12 years, there have been so many developments in this field that the latest edition, Volume 3, has been virtually rewritten. Over 80% of the material is new or revised.

Content aside, the indexing and referencing is magnificent. The Introduction contains a one paragraph summary of every sub-section in the book — there are 86 in all. Imagine the time saved in locating a topic; no more scanning through dozens of pages to decide whether it's worth reading an article.

The Handbook has one of the most comprehensive indexes this reviewer has ever seen in a single volume — 63 pages in all. In conjunction with a long reference list for each section, this is a valuable feature in locating obscure topics.

Reading through the first section ("Measurement Fundamentals"), the text settles into a comfortable, concise style. This is maintained throughout the book; techniques such as mass spectrometry and continuous nuclear weight scales are not in the least intimidating.

In general, the Handbook seems to have a sensible balance of textual expla-

## MASTER ELECTRONICS NOW! The PRACTICAL way!

This new style course will enable anyone to have a real understanding of electronics by a modern, practical and visual method. No previous knowledge is required, no maths, and an absolute minimum of theory.

You learn the practical, way in easy steps mastering all the essentials of your hobby or to start or further a career in electronics or as a self-employed servicing engineer.

All the training can be carried out in the comfort of your own home and at your own pace. A tutor is available to whom you can write personally at any time, for advice or help during your work. A Certificate is given at the end of every course.

You will do the following:

- Build a modern oscilloscope
- Recognise and handle current electronic components
- Read, draw and understand circuit diagrams
- Carry out 40 experiments on basic electronic circuits used in modern equipment
- Build and use digital electronic circuits and current solid state 'chips'
- Learn how to test and service every type of electronic device used in industry and commerce today. Servicing of radio, T.V., Hi-Fi and microprocessor/computer equipment.

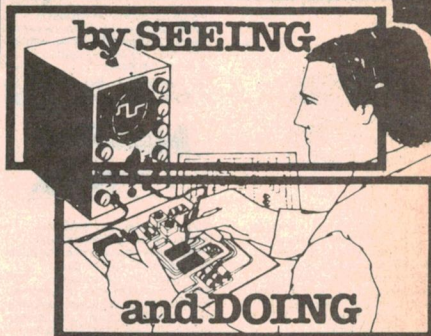
New Job? New Career? New Hobby? Get into **Electronics Now!**

Post coupon now:

**The Australian School of Electronics,**  
PO Box 108, Glen Iris,  
Victoria, 3146

A Registered  
Correspondence College

**FREE**  
COLOUR BROCHURE



Please send your brochure without any obligation to:

Name \_\_\_\_\_

Address \_\_\_\_\_

Post Code \_\_\_\_\_



nations and mathematical formulae. The development of formulae is not given. Rather, a set of standard equations will be given where needed. For example, the section on cavitation lists "bore diameter" equations for various types of pipes and venturis for rough and smooth surfaces.

In short, this is a text we can highly recommend for anyone studying or lecturing in the area of instruments and control. To state the obvious though, it is expensive. Our copy came from the publisher. (C.R.D.)

## Food for active filter feeders

**ACTIVE-FILTER COOKBOOK:** by Don Lancaster. Published 1985 by Howard W. Sams & Co., Inc. Soft covers, 240 pages. Illustrated with graphs, tables and circuits. ISBN 0-672-21168-8. Retail price \$19.95.

Active filters are important building blocks used in modern electronic circuits and this book provides a very comprehensive practical study of the subject. It is in fact one of the standard references on the subject, having been first published in 1975. The passing years have not made it any less relevant although it could have benefited from the inclusion of references to many of the newer types of op amps, such as those with Fet inputs.

The first chapters introduce the basics of active filters, describe the various types, and define terms and concepts. Operational amplifiers are also discussed since these are important for use as the gain block in active filters.

Normalisation and scaling techniques are used throughout the text to simplify the active filter designs.

For each of the low pass, band pass and high pass filter types, designs are given for up to sixth order. Graphs are used to show the response for various damping factors.

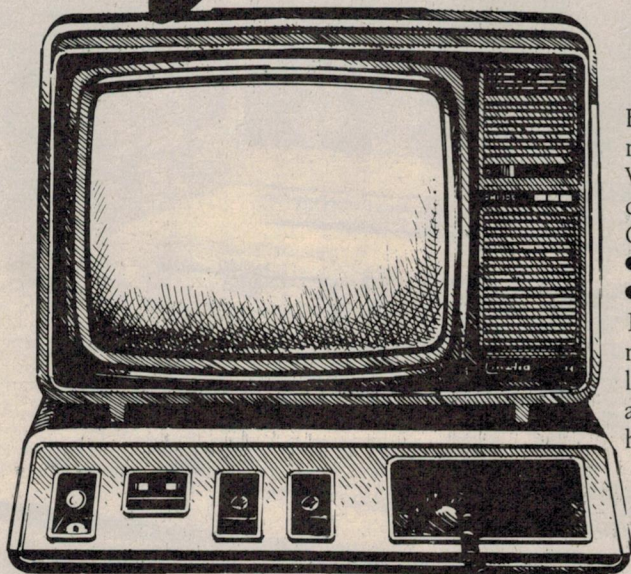
The basic equations for each of the filter transfer functions are given but for the non-mathematically inclined it is not necessary to understand these. All the most used response characteristics such as Bessel, Butterworth, Cauer and Chebyshev, are discussed.

Overall, the book is excellent for those wanting information on active filters. It is by no means exhaustive though, and the references at the rear of the book should be useful for readers requiring greater background on the subject.

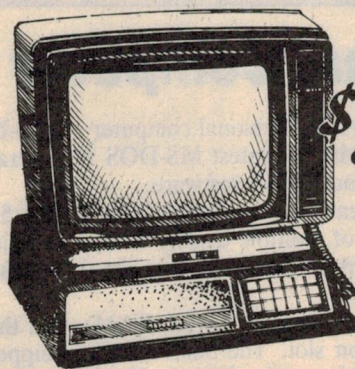
Our review copy came from Dick Smith Electronics Pty Ltd. (J.C.)

## Pre-loved Information Packages Just:

# \$449.00\*



Ex-rental, expertly maintained, Philips Videotex package consists of: • RGB Colour Monitor – 14" • Videotex Decoder • Internal Autodial 1200/75 • Modem • All necessary connecting leads • Telecom approved. Ideal for home use or for parts.



# \$349\*

Great Value Videotex Decoder. • Internal Autodial Modem 1200/75 • Infra Red Keypad • Connects to any UHF TV.



# \$149\*

Ex-rental, expertly maintained package consists of:  
• RGB Colour Monitor – 14"  
• Videotex Decoder  
• RS232 Connection  
• Numeric Keypad.  
(Package for connection to external modem.)

\*Packaging and delivery extra for interstate and country orders.

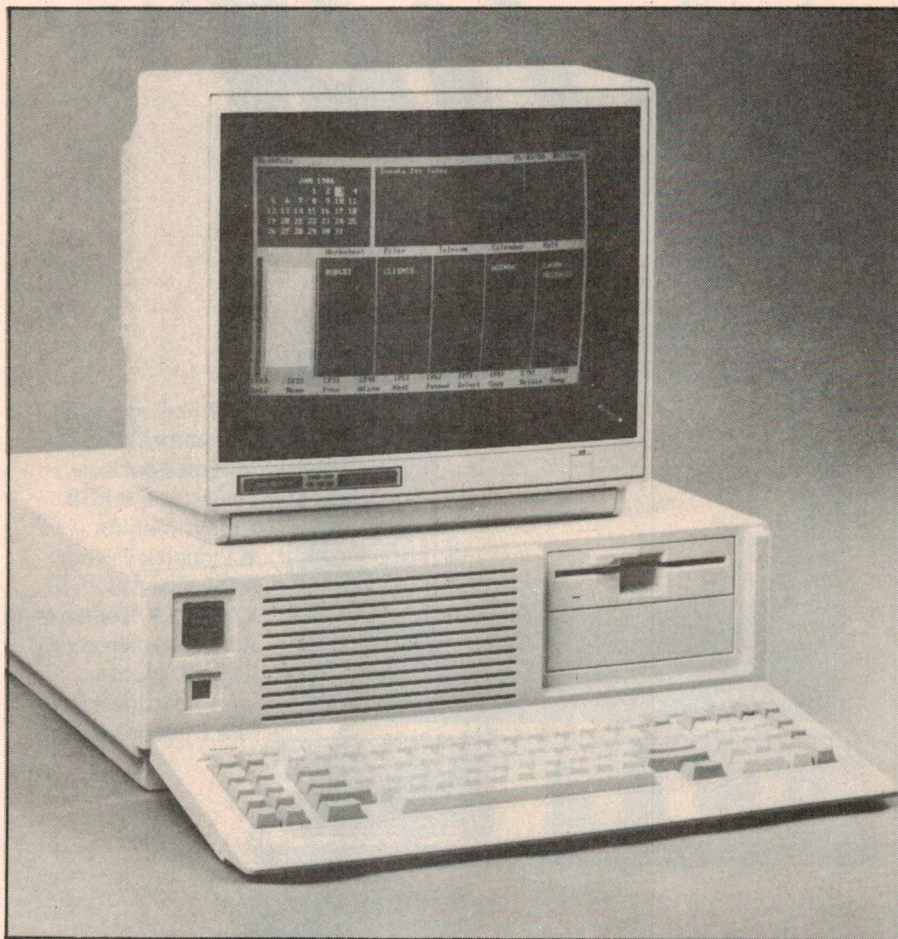
Return to base 90 day parts and labour warranty on all units.

For enquiries call  
SYDNEY (02) 959 6500 MELBOURNE (03) 699 3144



# New Products...

Product reviews, releases & services



## Tandy 3000 personal computer

Designed around Intel's 80286 chip, the Tandy 3000 personal computer is a 16-bit machine that operates at 8MHz. It is available with the latest MS-DOS 3.1 operating system and is compatible with IBM PC/AT and PC/XT software.

Tandy has designed the computer so that it can use the forthcoming Xenix 5.0 multi-user operating system. This allows the use of multiple display units with a single central processor, thus allowing up to six users to use the system simultaneously and to share common peripherals.

The Tandy 3000 comes with 1/2 M-byte of main memory (512K RAM), and this is expandable to 640K without using an expansion slot. The 3000 is also equipped with a high-capacity 13cm slimline floppy disk drive and a built-in 20 M-byte hard disk drive for fast access to stored data.

There are 10 expansion slots: seven PC/AT compatible, 2 PC/XT compatible and 1 PC/XT compatible half-slot for a serial/parallel adaptor. By using these expansion slots, the main memory can be extended to 12 M-bytes. Disk storage is expandable to include two floppy disk drives and one hard disk drive, or one floppy disk and two internal hard disk drives.

The total internal storage capacity can thus exceed 40 M-bytes.

A wide range of software is available, including programs that are currently being used by the Tandy 2000, Tandy 1000, and IBM PC machines.

For further information contact Tandy Electronics, 91 Kurrajong Avenue, Mt Druitt, NSW 2770. Telephone (02) 675 1222.

## Demonstration centre for personal computers

Total Electronics has opened its new demonstration centre for personal computer system's products. The products include the Ericsson-PC, Standard Microsystems' ARCNET Local Area Networking Boards and software, and Memory Controller boards for IBM-PC compatibles, and Intel Corporation's "IDIS" Database Link and their range of Xenix-based microcomputer systems.

The centres are located at 9 Harker Street, Burwood, Victoria and Campbell Street, Artarmon NSW. Currently they house Ericsson PCs linked in ARCNET and IDIS configurations and Intel 286/310 systems running Intel's RCCX realtime multitasking operating system and Xenix operating system.

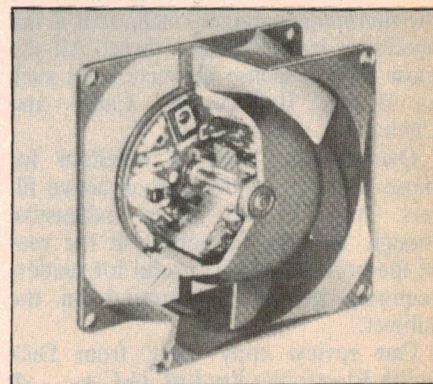
Various applications software packages are also available for demonstration, including the "Open Access" integrated package and the "Attache" financial package.

## Brushless DC fans

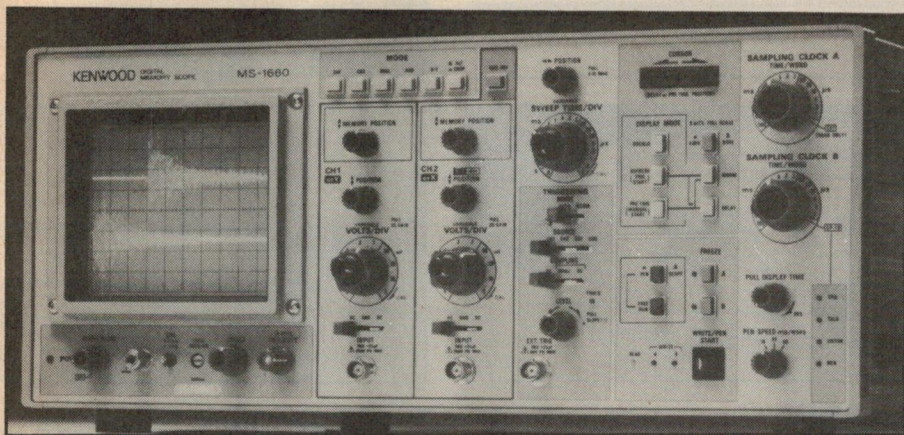
Driven by brushless DC motors with electronic commutation, and equipped with precision ball bearings, PAPST axial fans feature low power consumption, a life expectancy of 35,000 hours at a permissible ambient temperature of 65°C, low noise levels and low EMI and RFI emissions.

The fans are suitable for cooling video terminals and switching power supplies.

For further information contact Adilam Electronics, Suite 7, 145 Parker Street, Templestowe, Vic. 3105. Telephone (03) 846 2511.







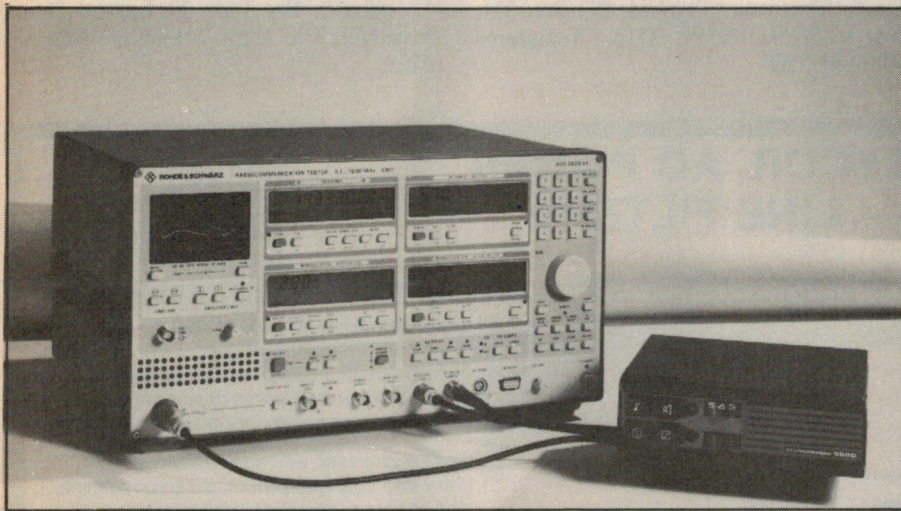
## Digital memory oscilloscope

Trio/Kenwood has released, through Parameters, the MS1660 which is a 2-channel 20MHz oscilloscope. One of its features includes the ability to store a signal even when powered off. It features two input channels with an 8-bit by 2048 word memory for each channel and completely independent clocks,

enabling easy waveform expansion and compression.

In addition, the MS-1660 features a GP-1B remote control capability, pen free-run mode operation, a cursor display and a battery backed-up memory, as well as the full range of normal oscilloscope functions.

For further details contact Parameters Pty Ltd, 25-27 Paul Street, North Ryde, NSW 2113. Telephone (02) 888 8777.



## Radio communications test unit

The CMT Radiocommunications Tester developed by Rohde & Schwarz can be used for both mobile and workshop servicing of transceivers.

The CMT has complete manual control, fully automatic operation via the autorun control facility, with data logging by printer, or control via the IEEE-488 bus option with the aid of an external controller.

With the four large illuminated displays incorporating digital and analog readouts with high resolution, switch selected range hold and defined scaling plus an oscilloscope screen, the user can

see all the test parameters and measured values at a glance and judge their interrelation.

Numerous integrated test routines can be called up and an alphanumeric display is provided for indication of special functions.

A plug in transfer memory for the CMT allows transfer of complete test routines to other testers and enhances the memory capacity. The memory is non-volatile.

For further information contact Rohde & Schwarz, 13-15 Wentworth Avenue, Darlinghurst, NSW 2010.

# EASTCOM

Eastern Communication Centre

## ELECTRONIC BROKERS AUSTRALIA

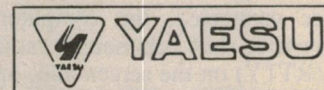
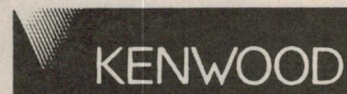
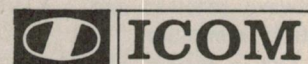
Communication, Electronics, Computer and Test Equipment.

168 Elgar Road,  
Wattle Park,  
Vic. 3128

288 3611 288 3107

Keith or Dave

We carry full range of:



Ham, SWL, CB and Communication gear, accessories etc.

### WE WILL TRADE!

ALL IBM and Apple Compatible Computers, Hardware, Software and accessories available. Demonstrations available.

HAM PACK III MODEM for IBM and APPLE. Ring for details.

### A FULL RANGE OF COMPONENTS

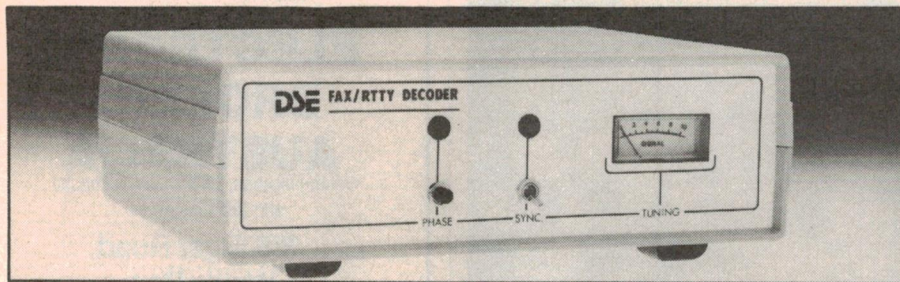
Large range of New and Secondhand Test Equipment available, stock changing daily.

**Full service and changeover available from our new Computer Service Centre. Repairs to Disc Drives a speciality.**

**COMPUTER SERVICES CONTRACTS AVAILABLE**



## New Products...



### Fax 7 decoder for CAT computer

Dick Smith Electronics Pty Ltd has introduced a new Fax and RTTY decoder for the CAT computer. It comes in kit form and can be used with a shortwave receiver and a CAT (or compatible) computer.

The Fax 7 RTTY Decoder accepts frequency-shift-keyed (FSK) tones from an HF receiver, decodes these into bit serial data and applies this to the computer.

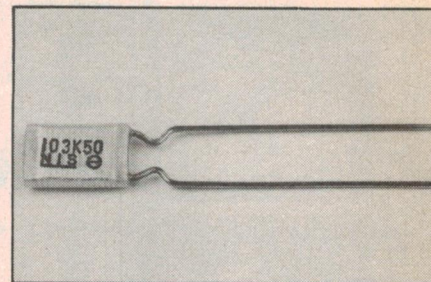
Once connected, the computer can display wide-shift commercial radioteletype (RTTY) on the screen and, optionally, on a printer. Alternatively, it can

display facsimile (FAX) weather pictures on the printer.

Software supplied with the decoder translates the bit serial data into either ASCII characters, or formatted pixel patterns for display on the printer. The decoder also features crystal locked synchronisation which provides skew-free pictures under adverse receiving conditions.

For further information contact Dick Smith Electronics Pty Ltd, PO Box 321, North Ryde, NSW 2113. Telephone (02) 888 3200.

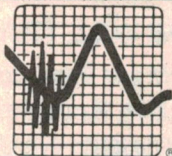
## Miniature polyester capacitors



Manufactured in Japan by Nissei Co Ltd, the AMZ miniature polyester capacitor is specifically designed for radial PCB insertion and is supplied on bandolier tape conforming to the 5mm industry standard, lead spacing pitch. This is suitable for most popular radial insertion machines.

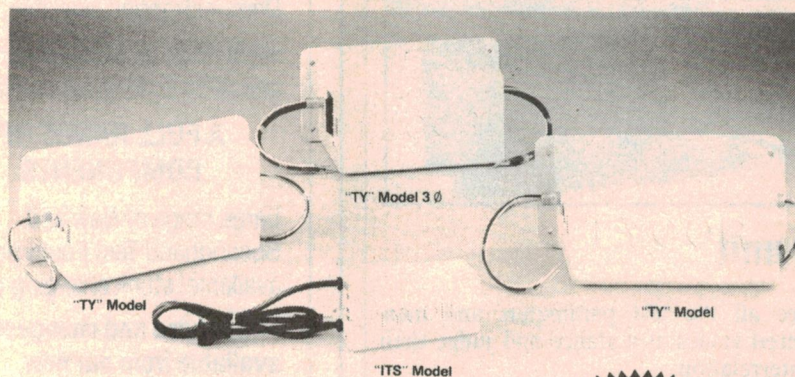
The stock range includes capacitance values from .0047 $\mu$ F to 0.47 $\mu$ F in 50V DCW with 10% tolerance. Higher voltages and/or close tolerance 5% types are also available.

For further details contact Soanar Electronics Pty Ltd, 30 Lexton Road, Box Hill, Vic 3128. Telephone (03) 895 0222.



## TYCOR® AC POWER LINE FILTERS

HEAVY INDUSTRY — BUSINESS/COMMERCIAL — EDUCATIONAL — MEDICAL — MILITARY — COMMUNICATIONS



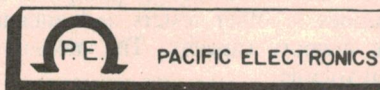
In our computer orientated society, AC power protection for modern microprocessor based equipment and other sensitive electronic devices is becoming increasingly important.

If not recognised and corrected prior to entry into your equipment, these power line disturbances will result in expensive damage being inflicted on both your hardware and software.

The TYCOR AC Power Line Filter is designed to eliminate more than 99% of all power problems including lightning strikes, transients, spikes, AC power line noise, RFI and EMI with models suitable for personal computers to mainframes.



**TYCOR®**  
**THE POWERFUL SOLUTION**



PACIFIC ELECTRONICS

PTY LTD

45 WELLINGTON STREET  
WINDSOR, VIC. 3181  
Phone (03) 529 8500  
Telex AA38432



# Eagle ELECTRONICS

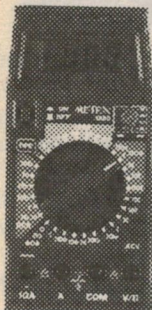
54 UNLEY ROAD, UNLEY  
SOUTH AUSTRALIA 5061

PHONE: (08) 271 2885

**EXPERT  
ADVICE!**

**JAYCAR — THE S.A. CONNECTION**

**S.A.'s NEWEST SHOP FOR THE HOBBYIST!**



**10A DIGITAL  
MULTIMETER**

**\$89<sup>95</sup>**

**SCOOP  
PURCHASE!**

**SHIELDED  
AUDIO CABLE**

**\$10** PER 100 M ROLL **Normally \$35.00**

**REMOTE CONTROL FOR AM/FM TUNER**

Sit back and relax. Full control from your armchair. Complete kit.

**\$89<sup>50</sup>**

**UHF/VHF CONVERTER**

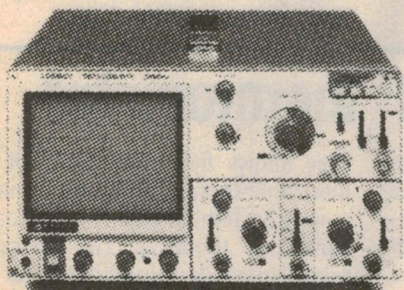
This kit is half the price of a built-up unit.

ONLY **\$59<sup>50</sup>**

**C.D. ADAPTOR**

This device allows you to play your compact disc Walkman through your car sound system.

ONLY **\$32**



**KIKUSUI COS 5020**

Compare the features and you'll see at this price it's essential.

**2-YEAR WARRANTY \$745**



**AEM 6103  
10" 3-Way  
Speaker  
System**

David Tilbrook's newest superb quality speakers.

**\$790**

Exclusive custom wood cabinet pack **\$175**

Also we have a comprehensive range of House and Car Alarms.

★ **TECHNICAL ASSISTANCE IS AVAILABLE FROM OUR WILLING STAFF TO HELP NOVICE AND EXPERIENCED BUILDERS ALIKE. IF YOU ARE HAVING TROUBLE, LET US HELP YOU PUT IT TOGETHER.** ★

**JAYCAR  
CATALOGUE  
NOW  
HERE!**

**MAIL AND PHONE ORDERS WELCOME.**

**Eagle Electronics Pty. Ltd.**

54 Unley Road, Unley, S.A. 5061

TELEPHONE:  
**(08) 271 2885**

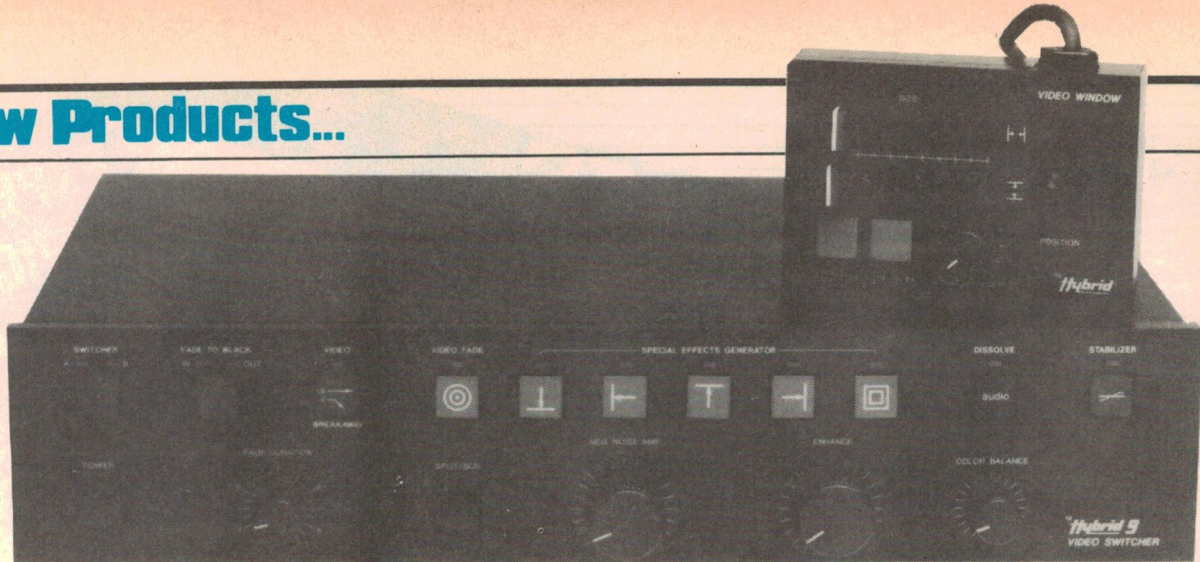
ALLOW \$10 FREIGHT  
CHARGE FOR ORDERS  
UNDER \$100.



NORTHERN TERRITORY RESIDENTS PHONE (089) 27 5899



## New Products...



### Hybrid-9 Video Switcher

New from Odyl Communications Pty Ltd is this, the Hybrid-9 Video Switcher. This is a special effects unit for domestic and semi-professional video production work. It incorporates a video switcher and fader, video enhancer, audio dissolver and automatic vertical sync stabiliser.

Primarily, the Hybrid-9 is an editing tool and can do many of the fancy video fades and wipes that are routine to the professional video production houses. It can also be regarded as a versatile and highly effective video switcher for connection of two VCRs in a domestic video suite. It has input facilities for two VCRs or any two video sources which could be a VCR, laserdisc player or camera. Associated with these can be

two stereo audio inputs so that stereo VCRs can be handled.

The inputs are mixed and faded to provide three separate video outputs and three stereo audio outputs. As well, one of the video/audio outputs may be made available from the RF output which can be on Australian channel 3 or 4.

On the front panel are five buttons associated with the special effects generator which may be used separately or in combination to provide a variety of video wipes from the screen. Thus, you can wipe from left to right or vice versa, upward, downwards or combinations of these.

You can also fade in or out of black and vary the duration of the fade.

The enhancer is supplemented by a "negative noise amplifier" control which counteracts any undue emphasis of snow in the picture. While the literature accompanying the Hybrid-9 does not explain how it works, we assume that it is a high frequency rolloff circuit with adjustable turnover point.

Also available with the Hybrid-9 is the Video Window remote control which plugs into the rear of the main unit. The remote control allows further variations on the video wipe facilities, with windows of varying size which can be moved on the screen via a joystick control.

Recommended retail price of the Hybrid-9 is \$1298.00. Further information can be obtained from the Australian distributors, Odyl Communications Pty Ltd, 112 James Street, Templestowe, 3106. Phone (03) 846 3022.

### High-power op amp

Packaged in a plastic case similar to the T0-220, Siemens' new TCA1365 power operational amplifier can deliver an output current of up to 3.5 A at a maximum supply voltage of  $\pm 21V$ . The circuit is protected against short-circuiting and thermal overload.

The TCA1365 operates at a junction temperature of up to  $150^{\circ}C$  and its power dissipation is 13W. During operation the package temperature may range from  $-25$  to  $+85^{\circ}C$ .

Other features include external compensation and integrated protection diodes. One pin of the circuit is electrically connected with the cooling tab.

For further information contact Siemens Ltd, 544 Church Street, Richmond, Vic. 3121. Telephone (03) 420 7204.

### Hand-held digital thermometer

Fluke has introduced its first two handheld digital thermometers, the Fluke 51 and 52. This 50 series are simple to operate and are the only handheld thermometers backed by a three year warranty.

They are housed in rugged ABS-plastic cases similar to Fluke 70 Series analog/digital multimeters.

The Fluke 51 is a single input unit while the Fluke 52 features dual inputs as well as scanning and recording modes. They can operate with either J- or K-type thermocouples and offer 0.1% accuracy over an ambient operating range of  $18$  to  $28^{\circ}C$  ( $64$  to  $82^{\circ}F$ ).

Both have  $0.1^{\circ}C$  resolution across the specified range for either thermocouple type.

An unusual feature of the series is an offset pot for each thermocouple input.

This allows field calibration of a thermocouple-thermometer combination to a specific temperature for increased accuracy, if required. The operator can select for readout in either  $^{\circ}C$  or  $^{\circ}F$ .

Pushbutton controls are used to select all functions, and include a 'reading hold' button which freezes the display. An open thermocouple/wire detection feature is included on all inputs.

A general purpose bead thermocouple is included with the Fluke 51, while two bead thermocouples are supplied with the dual input Fluke 52. Additional bead thermocouples are available as accessories, as are immersion probes, air probes, and piercing (316 stainless steel) probes.

For further information contact Elmeasco, PO Box 30, Concord, NSW 2137. Telephone (02) 736 2888.

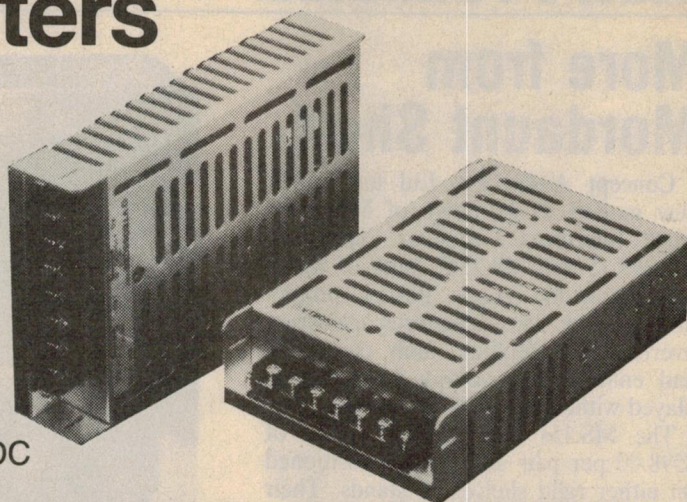


# DC/DC converters

**NOW AVAILABLE OFF THE SHELF,  
29 MODELS OF DC INPUT SWITCH  
MODE POWER SUPPLIES**

## FEATURES

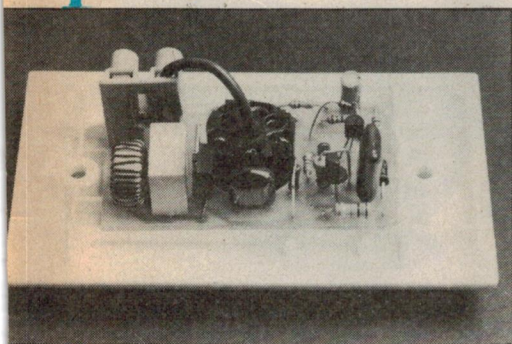
- INPUT-OUTPUT ISOLATION
- FLOATING INPUT AND OUTPUT VOLTAGE ALLOWS EITHER POLARITY
- INPUT VOLTAGES: 12, 24 or 48 V DC
- OUTPUT VOLTAGES: 5, 12, 15, 24 V DC IN EITHER POLARITY IN SINGLE, DUAL OR TRIPLE CONFIGURATION
- OUTPUT POWER: 12.5, 15, 40 or 50 WATT
- SHORT CIRCUIT PROTECTION
- OVER VOLTAGE PROTECTION
- HIGH EFFICIENCY SWITCH MODE
- LIGHT WEIGHT: 250 and 420 GM
- ENCLOSED BOX FOR SHIELDING AND EASY MOUNTING



**AMTEX**  
ELECTRONICS

A DIVISION OF TLE ELECTRICAL PTY LTD  
36 LISBON ST FAIRFIELD, NSW 2165  
Telephone: (02) 728 2121, 727 5444  
Telex: AA27922 Attn Amtex  
Facsimile: (02) 728 2837

## Build a 240V lamp saver



Does your house eat lamps? Those expensive downlights and spotlights? Every year, you probably replace quite a few of these lamps at \$5-7 a pop. This inexpensive Triac circuit should extend lamp life considerably. It incorporates overvoltage protection and soft starting.

## Next month in Electronics Australia

### Phone controller for mains appliances

Ring-a-ding-ding! Ting-a-ling, ding-a-ling! Dial your home number and remotely turn an appliance on and off without paying for the phone call. You can turn on outside lights, a spa or an electric blanket. We tell you how to build it in the June issue.

### Playmaster 60-60 stereo amplifier

Next month, we will present the full circuit details for our new Playmaster 60-60 stereo amplifier. It outperforms commercial amplifiers costing much more, is delightfully easy to build, and should sell for quite a bit less than \$250.

*Note: Although these articles have been prepared for publication, circumstances may change the final content.*



## New Products...

### More from Mordaunt Short

Concept Audio Pty Ltd has added new models to its range of Mordaunt Short loudspeaker systems. They are the MS.15 and MS.25Ti, both of which incorporate the unique 'Positec' protection circuitry. This safeguards against an overload or amplifier fault condition, and enables high volume levels to be played without the risk of damage.

The MS.15s have a retail price of \$598.00 per pair and can be positioned on either rigid shelves or stands. Their specifications include a 165mm bass unit cone and a 12mm synthetic dome tweeter. Sensitivity is 87dB for 1W at 1 metre, a maximum SPL of 107dB peak, and dimensions of 325mm (H) x 225mm (W) x 172mm (D).

The MS.25Ti has a 200mm bass driver and a 19mm titanium dome tweeter, while sensitivity is specified at 89dB for 1W at 1 metre. The maximum sound pressure level (SPL) is 112dB peak and



the system sells for \$698.00 per pair.

For further information contact Concept Audio Pty Ltd, 17/98 Old Pittwater Road, Brookvale, NSW 2100. Telephone (02) 938 3700.

### Pocket-size digital thermometer

The Mini-Therm Pocket Digital Thermometer (model AD15TH) is a pocket-size digital thermometer measuring 90 x 60 x 25mm and weighing just 97g complete with probe and battery.

The device is factory pre-calibrated and low in cost. As a general purpose thermometer it covers the most used range of  $-40^{\circ}\text{C}$  to  $+120^{\circ}\text{C}$ . Resolution is  $0.1^{\circ}\text{C}$  and the unit has a stated accuracy of  $\pm 0.3^{\circ}\text{C} \pm 1$  digit.

The read out is by liquid crystal display with 8mm LCD characters and the sensor is a semiconductor type. A 30mm long x 2.2mm diameter probe with an integral lead is also supplied.

The probe has a typical response time of three seconds and has been designed for use in measuring the temperatures of air and gasses and for insertion into soft materials.

A 9V battery is supplied which has a life of typically 1000 hours. An automatic battery check inhibits faulty readings when the battery is low.

For further information contact Warsash Pty Ltd, PO Box 217, Double Bay, NSW 2028. Telephone (02) 30 6815.

## ALTRONICS PRODUCTS IN ADELAIDE

All the exciting Altronics Products and advertised specials in the Altronics advertisements in this magazine are available in S.A. from **FORCE ELECTRONICS**, your dynamic Altronics S.A. dealers.

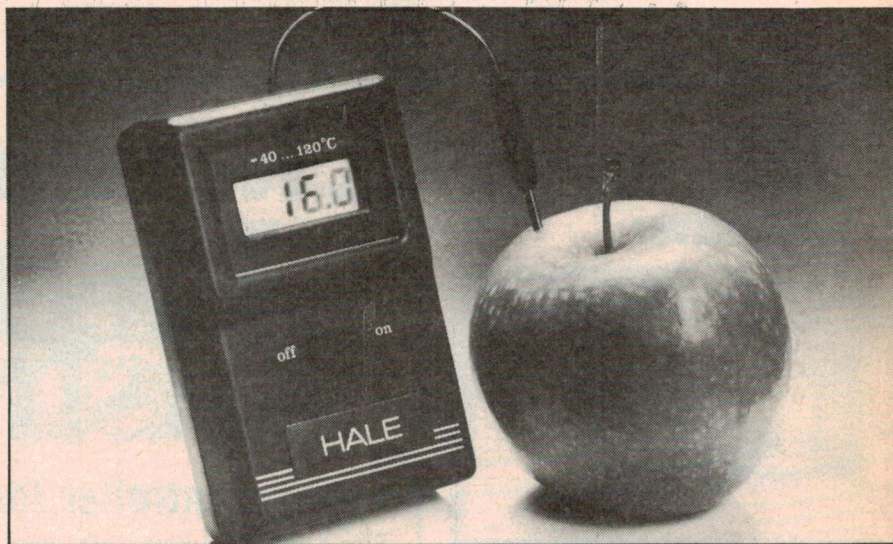
Call in this month for a free  
**Altronics 1986 Catalogue!**

### FORCE ELECTRONICS

203 WRIGHT ST.  
ADELAIDE, PH: 212 2672

ALSO AT CHRISTIES BEACH  
PHONE 382 3366

AND REYNELLA  
PHONE 383 2824



### Ultrasonic transducers for burglar alarms

IRH Components now carry two Murata high-sensitivity, broadband ultrasonic transducers for use in security applications. Type MA40L1 (PCB mounted) and MA40L2 (phono jack socket) are small in size and very light. Both operate at a nominal frequency of 40kHz. The receiver type has a sensi-

tivity of  $-65\text{dB/V/UBAR}$  while the transmitter type produces a guaranteed maximum level of 110dB. Capacitance is 1700pF and the maximum input voltage is 20V rms.

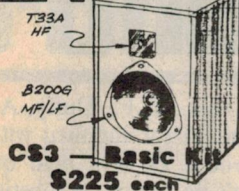
Two other types are available for burglar alarm systems and both may be used as transmitters or receivers.

For further information, contact IRH Components, 32 Parramatta Road, Lidcombe, 2141. Telephone: (02) 648 5455.





## CONSTRUCTOR SERIES SPEAKERS



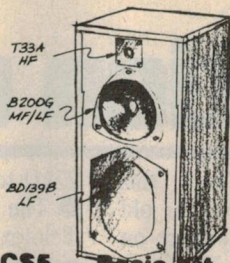
**CS3 — Basic Kit**  
**\$225 each**

This very high quality bookshelf loudspeaker is based on the KEF MODEL 103.2, utilising the same drive units.

It is a two-way system specially designed for the home constructor.

The drive unit complement comprises a 200mm Bextrene cone LF unit and a 25mm HF dome radiator.

Model CS3 is capable of very high quality performance and can out-perform some of the best loudspeakers available.

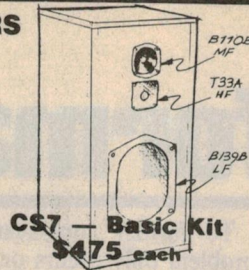


**CS5 — Basic Kit**  
**\$300 each**

This floor-standing loudspeaker has an extended low-frequency performance and provides remarkable sharp stereo imaging.

It features a 200mm diameter Bextrene cone LF drive unit with a passive bass radiator and a 25mm dome HF radiator.

Model CS5 will reproduce the full frequency range available from the best modern recordings with outstanding clarity and low distortion.



**CS7 — Basic Kit**  
**\$475 each**

This is a full three-way loudspeaker system employing the KEF B 139 which is the world's most famous bass driver fitted with a flat diaphragm originally developed by KEF over 20 years ago. The mid-range unit features a Bextrene cone diaphragm and PVC roll surround. High frequencies are handled by a 25mm dome radiator. This remarkable system has an extended bass response and excellent power handling capacity. The computer designed crossover network gives a very smooth frequency response characteristic and ensures finely detailed reproduction of critical mid-range information.

**Save money — have fun — building a pair of world famous KEF Constructor Series kits from AUDIOCRAFT. We deliver direct to your door anywhere in Australia & save you up to 50%. Phone or write now for your complementary KEF Constructor Series manual & price list.**

**PHONE (07) 870 8785**

P O Box 725 Toowong  
BRISBANE Qld 4066  
AUSTRALIA

(See our add in EA Marketplace at rear of this magazine for details on other Kits & Accessories available)

**AUDIOCRAFT**

Australia's Hi-Fi loudspeaker  
kit specialists.

## DTMF MICROPHONES

**\$105 each**

**\$95 each 10+**

**\$90 each 100+**

**plus sales tax**



**Also  
available with  
DTMF selective  
calling**

**For other  
DTMF products  
send for catalogue**

**DNA**

**COMMUNICATIONS**

**P.O. BOX 47, ALSTONVILLE, NSW 2477  
TELEPHONE (066) 28 3454**

# "WHICH RADIO DO I NEED?"

**...THE ANSWER IS  
IN THE PALM  
OF YOUR HAND**

Whatever task you have to do the ICOM IC-40 is the one that can handle it.

It's ideally suited for farming, transport, sports, bushwalking & boating. Whatever the communication problem you need to solve this is the radio that's being

proven every day in a million different uses.

Contact your local dealer for a demonstration of the most advanced CRS portable available in Australia.



Please post to:

ICOM AUSTRALIA PTY. LTD.  
7 DUKE STREET WINDSOR 3182.  
VICTORIA.

Name

Address

City

Postcode

or phone ICOM on (03) 51 2284

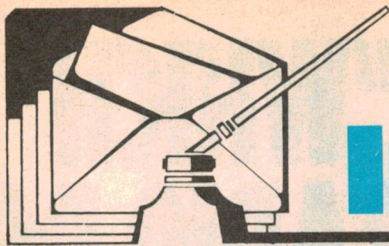


**ICOM**

**The World System**

IC0014





# Information centre

## Problem with Teletext Decoder

I am hoping that you can help me with a problem I have with the Teletext Decoder kit (EA, August 1984).

The teletext function works very well with the clock updating on the screen, good graphics and good colours. However, the picture quality is terrible, to the point of being unwatchable.

The picture has interference lines running diagonally across the screen at about 45°. The lines are alternatively dark and light, evenly spaced about 1-2mm apart. As well, there are about 10 vertical bars unevenly spaced across the screen, each about 5mm wide, changing colour from green to a reddish pink quite randomly. These lines stop in a straight line at about 12mm from the bottom of the screen.

In addition, the picture frequently suffers from sideways tearing and loss of vertical hold, the latter occurring only in teletext mode. The interference is present regardless as to whether TV, teletext or mix is selected.

The diagonal interference lines improve considerably when the RF out earth shield is moved slightly to touch the chassis. The vertical lines remain unchanged. However, this improvement does not remain if a jumper lead is clipped from the earth shield to the chassis.

To further complicate matters, this problem only occurs on my 10-year old JVC 7765 AU 48cm TV; the picture on a new Toshiba 147E3A 34cm TV is almost faultless. Only a faint trace of the diagonal lines is evident and there are no vertical lines. There is no sideways tearing, but loss of vertical hold still occurs in teletext mode.

The picture quality is good if the Video Out from the decoder is connected to the direct video input on my JVC (modified as per the EA article in August 1983). This made me suspect the modulator which Dick Smith Electronics replaced at no charge. However, the new modulator didn't change anything.

Using direct video is of no use to me, as the Teletext Decoder is for my deaf sister whose Philips TV (only slightly younger than my JVC) has no video input. The picture quality on the Philips is equally appalling.

I have tried adjusting VR5 and both slugs in the modulator, but all to no avail. I also had a couple of problems with construction. First, the board overlay and assembly instructions show C49 mounted with reverse polarity when compared to the circuit diagram and the actual DC voltage levels present on the circuit. I mounted it opposite that shown on the overlay.

Second, the audio level was muted in the TV mode and broke through in the teletext mode at a very high and distorted volume. I had to change R80 to

22kΩ to cure that. (G.F., Duffy, ACT).

● The RF modulator supplied with the Teletext Decoder kit is a high quality unit, so there's no reason to substitute a different type. In fact, the original unit is capable of supplying a first rate picture.

From your description of the fault, it's possible that the interference is due to radiation from the Teletext Decoder finding its way into the RF front end of your TV set. Make sure that the lid is on the chassis and that it has been screwed down. This measure should provide adequate RF shielding.

If that doesn't do the trick, try connecting a 0.1μF bypass capacitor between chassis and the metal case of the modulator. Also, keep the Teletext Decoder and the TV set as far apart as practicable.

## Parts for Car Stereo Amplifier

I am writing regarding the 100W Car Stereo Amplifier published in August and September 1985. My problem is that I have been unable to obtain the Neosid iron powder ring cores, types 17-131-10 and 17-137-10. I have contacted Siemens and Philips but they do not recognise the part numbers.

I would be very pleased if you could tell me where I can buy these parts — preferably in Melbourne. (D.S., Lilydale, Vic).

## Driveway Sentry false triggers

I originally bought the 1982 version of the Driveway Sentry, but encountered difficulties. When the MK.2 version was published in March 1985, I duly pulled the first project apart, bought the necessary parts, and rebuilt the project.

The problem is that it triggers OK but does not shut off. One can hear the relay clicking but it does not allow the light to go off. By connecting another resistor in parallel with the timing resistor, I can get it to function but this does not give enough time to get from the car to the front door — we have a steep path to climb.

Both LDRs function well and other

parts seem to check out — I feel that the problem is with the relay somehow. (H.W., Mt. Eliza, Vic).

● It is almost certain that your Driveway Sentry Mk.2 is being retriggered by the inductive kickback of the relay coil. Diode D5, which is across the relay coil, is included to prevent this. Check that this diode is OK and that it has been installed with the correct polarity.

If D5 checks out, other measures to prevent the circuit from retriggering will be necessary. The first step is to determine whether the problem lies in IC1 or IC2. This can be done by removing D3

from circuit and then triggering the circuit manually by pressing S1.

If the problem persists, IC2 is at fault; if not, the fault lies with IC1.

If IC2 is the cause, try decreasing the value of the 180kΩ resistor on pin 12. Assuming that this cures the problem, replace D3 and check that the circuit can still be triggered by the car's headlights. If not, increase the value of the .033μF electrolytic capacitor between pin 16 and ground.

This same decoupling technique can also be used on IC1, if it is the culprit (the V+ pin for IC1 is pin 14). Also try, increasing the value of the 0.1μF capacitor on pin 1 of IC1 (up to 1μF if necessary).



● Most parts retailers only sell the ring cores as part of a complete kit, and do not carry them as normal stock items. However, you can buy them separately from Phoenix Industrial, 168 Alexander St, Crows Nest, NSW 2065. Phone (02) 438 3966.

## Sensor for fuel consumption meter

Recently, I started constructing the analog fuel consumption meter that was featured in your magazine in March 1983. However, I cannot find any stocks of the Moray fuel sensor. Both Jaycar and Rod Irving Electronics assure me that I won't find one in Australia.

Could you please tell me where I can find stocks of the fuel sensor? Failing that, is the Dick Smith fuel flow sensor compatible? (C.C., Waratah West, NSW).

● Jaycar and Rod Irving Electronics are correct — the Moray fuel flow sensor is no longer available.

Although we haven't tried it, the fuel flow sensor used in the Sparkrite car computer and sold by Jaycar should be suitable. However, this unit delivers only one tenth the number of output pulses per litre when compared to the Moray unit. This will upset the calibration of the meter.

To overcome this problem, the PLL circuit will have to be modified from a 64 times multiplier to a 512 times multiplier. To do this, connect pin 3 of IC1 to pin 2 of IC2 (instead of to pin 4) and reduce the .0027 $\mu$ F capacitor between pins 6 and 7 of IC1 to 330pF.

The Dick Smith unit could also probably be made to work, but we are unfamiliar with its output characteristics. It too would probably require some modification to the multiplier circuit.

## Modifying the Playmaster tuner

I am really keen to build the FM tuner section only of your new Playmaster Stereo AM/FM Tuner, but with the manual control if possible. Is it possible to provide the varicap tuning voltage from a potentiometer, thus giving manual control? And how would the other unused outputs be terminated; ie the stop and mute outputs. (E.M., Manly West, Qld).

● Without really going into details, it should be possible to build a manually tuned FM-only version of the Playmaster tuner. You would have to incorporate automatic frequency control (AFC)

though, otherwise the tuner would drift too much to make it listenable for more than short periods at a time. You would need to take the AFT output of the LM1865 (pin 14) and mix it with the tuning voltage (from a multi-turn potentiometer) in an op amp circuit. You would also need to make the STOP output (pin 16) drive a LED to indicate a tuned condition.

Such a tuner could probably be built fairly cheaply although you may have difficulty obtaining some of the parts such as the varicaps and ceramic filters.

## Problem with AM stereo decoder

I write to you in the hope that you may be able to provide me with some assistance with the AM stereo decoder published in the October 1984 issue of your magazine.

I fitted the circuit to my Pioneer TX710 tuner, but am unable to get it to switch to stereo. The signal I get is of good quality (ie, it is noise-free) and the point to which I have connected it has a peak to peak voltage of about 1.5V. I have a 22k $\Omega$  resistor in series with the input and have tried increasing C1 to the recommended maximum.

The voltage on pin 19 of the chip is correct. However, the voltage on pin 10 is much higher than you suggest it should be, something in the region of 6.5-7V.

● The 6.5-7V measurement on pin 10 is satisfactory and indicates that the decoder is in lock. To achieve stereo reception, the input IF signal must be correct. We suggest that you monitor the voltage at pin 4 (the level detector output) and adjust the IF signal level to pin 3 by altering the series resistor until a reading of about 2V is obtained.

## Capacitors for Playmaster amplifier

I am at present building the Playmaster Series 200 Mosfet Amplifier from a kitset but have run into a few problems. The first problem is the availability of the 2% capacitors. The capacitors supplied with the kitset are greencaps said to have been selected to be within 2% of their nominal value. However, I have found them to be just within 4% of their nominal value which is hardly good enough for a "no-compromise" amplifier.


The second problem concerns a mysterious diode. This diode appears in the component overlay, makes a brief ap-

Valves! — Hundreds Of Types! — Send postage stamp for list.

# L. E. CHAPMAN

122 PITT ROAD, NTH CURL CURL  
MAIL ORDERS: BOX 156, DEE WHY, NSW. 2099.  
TELEPHONE 93-1848.

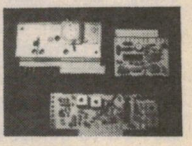
**SUPER SPECIAL**  
**BSR GRAMO MOTOR AND PICKUP 240V**  
3 speed 33-45-78 includes  
cartridge and  
stylus turnover



**\$12**  
P&P NSW \$2.75 INTERSTATE \$4.20 WA, NT \$5.20

**SUPER SPECIAL**  
**FM STEREO KITS**


World famous make. Sets of 3 modules includes FM Tuner, Decoder and IF detector. Circuit diagram supplied.



**ONLY \$22**  
**PP \$1.60**

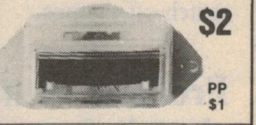
**BSR BELT SUPER SPECIAL DRIVE**

Recond player 2 speed 33 and 45 RPM 11 inch turntable pickup arm counter balanced cueing facility. Ceramic cartridge, diamond stylus works off 240V 9V or 12V.




**\$39**  
P.P. \$5.50

**SPECIAL**  
**BALANCE**  
**METERS**  
**CENTRE ZERO**



**\$2**  
PP \$1

**SPECIAL DUAL VU METERS**



**\$3**  
pp \$1

<b>TOUCH MICRO SWITCHES</b> 4 for \$1	<b>TRANSISTORS</b> AD 161-162 \$1 pair AD 149 \$2 pair
<b>MICRO SWITCHES</b> 5A 250 volt 50c.	<b>VALVE SOCKETS</b> 7 pin 4 for \$1 9 pin 4 for \$1 OCTAL 4 for \$1
<b>IF's 455kHz</b> For valve radios \$1 ea.	
<b>OSCILLATOR COILS</b> 75c	
<b>TAG STRIPS</b> Mixed 10 for \$1	<b>5 MIXED ROTARY SWITCHES</b> \$2.50
<b>MIXED SWITCHES</b> 12 for \$4.50	<b>CHROME 1/4 PUSH ON KNOBS</b> 10 for \$1
<b>MIXED RESISTORS</b> 100 for \$2 all handy values	<b>SLIDE POT KNOBS</b> 10 for \$1
<b>SHIELDED CABLE</b> Single strand. 25 metres for \$2.50	<b>MIXED CAPACITORS</b> Fresh stock 100 for \$2
<b>TOGGLE SWITCHES</b> 4 for \$1	<b>TV COLOUR CRYSTALS</b> 4433 — 619kHz \$2
<b>TRANSISTOR EARPIECE PLUG &amp; LEAD</b> 4 for \$1	<b>TRANSISTORS</b> MM 57186m \$4
<b>STICK RECTIFIERS</b> TV 20 SC \$1 each	<b>SPARK GAPS</b> 10 for \$1
<b>CAR RADIO SUPPRESSORS</b> 4 for \$1	<b>THERMISTERS</b> 4 for \$1
<b>SLIDE POTS</b>	
1 1/2 Meg DUAL \$1 1 Meg dual \$1 2 Meg dual \$2 250K dual \$1 1K dual \$1	5K single 50c 250K single 50c 10K single 50c 2 Meg single 50c 25K dual ganged \$1

stamp for list. Valves! — Hundreds Of Types! — Send postage



pearance in the photograph of the prototype, but does not appear in the schematic. Since the diode appears to be in series with part of the power supply, I cannot just leave it out.

I am enclosing a copy of the parts overlay with the offending diode marked. Incidentally, I note that this diode is not labelled as are all the other components.

I congratulate you on what is obviously the best electronics magazine available. (M.C., Emerald, Vic).

● Unfortunately, 2% capacitors are expensive and quite difficult to obtain. For this reason, kit suppliers have elected to select capacitors. The alternative is to contact Mayer Kreig & Company, 1 Eskay Rd, Oakleigh, Vic. 3167 (phone 03 579 5722).

The mysterious diode can be a general purpose type such as a 1N4001. It is mentioned in the article in May 1985 and is in series with the supply to the preamplifier. Its purpose is to prevent switch-off thumps.

## Problem with the electric fence

I have a query in relation to the electric fence controller described in December 1985.

In the text of the article (p36), it states: "the pulse transformer has a turns ratio of 20:1 and delivers an open circuit output voltage of 4kV etc". To achieve this turns ratio with a primary winding of 20 turns requires a secondary of 400 turns, but the circuit diagram and the text (p37-38) give the primary winding as 20 turns and the secondary as 120 turns — a turns ratio of 6:1.

With a primary voltage pulse of 270V and a turns ratio of 6:1, one would expect an open circuit output of approximately 1.6kV and, with a turns ratio of 20:1, an open circuit output of approximately 5.4kV. Please advise which is the correct turns ratio and also how you arrive at a figure of 4kV for the open circuit output voltage.

Finally, the text indicates that the 1 $\mu$ F output capacitor is charged via a 100k $\Omega$  series resistor. This value is included in the parts list, but the circuit and parts layout both show the value of this resistor as 220k $\Omega$ . (V.B., Armidale, NSW).

● With respect to the turns ratio, the constructional details and circuit diagram are correct; only the reference to

the 20:1 turns ratio in the text is incorrect.

Ostensibly, the 6:1 turns ratio would yield an output voltage of 1.6kV, but due to the resonance effects in the pulse transformer, the actual output is considerably higher. When the ringing is damped by a low impedance load, the output voltage is nearer to the expected value.

The resistor in series with the 1 $\mu$ F output capacitor is correctly shown as 220k $\Omega$  on the circuit diagram. While 100k $\Omega$  will work in most instances, 220k $\Omega$  is to be preferred.

Finally, the diodes in the parts list are incorrectly specified as 1N4002 types. They should, in fact, be 1N4007s as shown on the circuit diagram, otherwise their voltage rating will be insufficient.

## Buffer for Centronics printers

Have you ever published a project for a printer buffer for a Centronics type printer? If not, may I suggest it as a future project. (S.S., Port Hedland, WA).

● We have never published such a project but have considered doing so. How-

ever, we have not gone ahead with a design since it would be a fairly expensive project requiring quite a lot of RAM, a microprocessor and an EPROM. This brings the estimated cost to around \$150 or more.

Also, we are not too sure as to the degree of reader interest. Perhaps other readers may care to comment.

## Stereo TV sound receiver

I have a question concerning the article describing the Stereo TV Sound Receiver (EA, March 1985). I would like to know the unit's frequency response.

What confuses me is a reference to TV audio bandwidth. On page 80, under "Australian Stereo TV Transmission Standards", the text states: "the maximum deviation is 50kHz, the pre-emphasis is 50 $\mu$ s and the bandwidth is 40-1500Hz. Should this be 40-15,000Hz?

Is TV audio so poor, as I would have imagined it to be the same as FM sound? (T.O., Perth, WA).

● The text is in error. The audio bandwidth for TV sound is, as you suspected, flat from 40Hz to 15kHz.

## Notes & Errata

**100W VHF LINEAR AMPLIFIER** (March 1986, File 2/TR/62): several words have been omitted from the first sentence in step 4 in the alignment procedure, page 28. The sentence should read: "Temporarily connect the +13.8V supply rail to the cathode of D3 (base of Q3) via a 10k $\Omega$  resistor".

**CAR DASHBOARD LAMP FLASHER** (February 1986, File 32/AU/46): a 1 x 1 $\mu$ F 16VW electrolytic capacitor should be included in the parts list; not 1 x 10 $\mu$ F. The circuit and parts layout diagrams are correct.

**VIDEO FADER** (January 1986, File 6/TVT/5): the current limiting resistor for the LED is incorrectly shown on the circuit and parts layout diagrams as 2.2k $\Omega$ . The correct value is 220 $\Omega$ .

**MUSICAL DOORBELL** (May 1985, File 3/MS/117): in the overlay diagram on page 74, notes 5 and 9 are transposed, as are noted 14 and 18. Also the diodes associated with the note shown as 18 have the wrong polarity.

**PLAYMASTER SERIES 200 STEREO AMPLIFIER** (May 1985, 1/SA/71): a dual-gang linear MN PC-mounting

potentiometer (the balance control) should be added to the parts list.

**ELECTRIC FENCE CONTROLLER** (December 1985, File 3/MS/ 119): there are two errors in the text. The turns ratio of the pulse transformer is 6:1, not 20:1, while the resistor connected to the bridge output is 220k $\Omega$ , not 100k $\Omega$ . The parts list should be altered to read 2 x 220k $\Omega$  resistors, the 1 x 100k $\Omega$  resistor should be deleted and the 5 x 1N4002 diodes should be 1N4007 types.

The circuit and parts layout diagrams are correct.

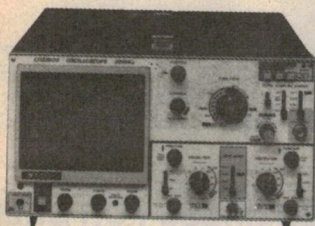
**DIGITAL STROBE** (March 1986, File 2/MS/64): diodes D3-D6 should be 1000V types; either 1N4007 or equivalent. Also, the 47 $\mu$ F 450VW electrolytic capacitor may be difficult to obtain. A 33 $\mu$ F 450VW capacitor may be substituted without loss of performance.

Finally, a track has been obliterated between two pads on the PCB pattern published on page 48. These pads are associated with the anode of one of the bridge rectifier diodes (D3-D6) and the adjacent wire link. The parts layout diagram is correct while the PCBs sold by parts retailers will also be OK.





## Quality Performance Value



### COS 5020

- 20MHz
- 2 Channel
- 2 year WARRANTY

Compare the features and you'll see that for our price, they're not worth being without.

1. Fast 20ns/DIV sweep speed — provides the resolution for timing measurements required of a 20MHz scope.
2. Trigger level lock — automatically sets trigger level, if selected, so there's no resetting between measurements.
3. Variable Hold Off — synchronises complex repetitive signals, like the BURST in a video signal.
4. Linear Auto Focus — maintains clear bright signal traces.
5. Sweep modes — AUTO, MANUAL and SINGLE SHOT.

### 2 QUALITY PROBES

10:1, 1:1  
INCLUDED

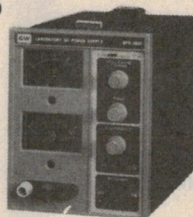
\$629 ex-tax  
\$729 inc. tax

## GW POWER SUPPLIES

### 2 NEW SERIES FOR '86

#### GPR-SERIES

- single output
- 2 analogue panel meters, V-A
- Fine & Coarse Voltage Control
- Fully protected, low noise
- Excellent value



GPR-SERIES

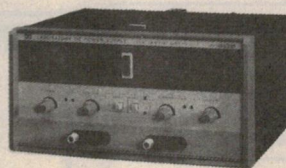
#### Typical Ranges:

GPR-1810: 18V, 1A  
GPR-1830: 18V, 3A  
GPR-3020: 30V, 2A

GPR-3030 30V, 3A  
GPR-3060 30V, 6A  
GPR-6030 60V, 3A

#### GPD-SERIES

The NEW GPD-series supplies have 2 variable outputs, which can be configured in anyone of 4 operating modes:



GPD-SERIES

- DUAL INDEPENDENT • DUAL TRACKING
- SERIES OPERATION • PARALLEL OPERATION

#### Typical Ranges:

GPD-1850: 2 x 18V, 5A or 36V, 5A or 18V, 10A  
GPD-3020: 2 x 30V, 2A or 60V, 2A or 30V, 4A  
GPD-3030: 2 x 30V, 3A or 60V, 3A or 30V, 6A

## PROTEL-PCB, LOW COST, PROFESSIONAL QUALITY, MULTILAYER PRINTED CIRCUIT BOARD DESIGN PROGRAM. FOR IBM\* OR COMPATIBLE COMPUTERS.

### VERSION 2.0

PROTEL-PCB software is written in Australia and lets you create correct and plot camera-ready artwork. PROTEL-PCB eliminates time consuming tape up methods. Version 2.0 of the popular software package has been released.

• Check the list of new features and you will see that the program has been further enhanced as a low cost professional quality program. The Program now allows the design of circuit boards to 32 x 19 inches. The user can view and work on the entire PC at once or with five levels of zoom work on particular areas as small as 1.6 x 0.95 inches on the full screen of the VDU. Camera ready 1:1 or 2:1 ink plots are available as is 1:1 or 2:1 rapid colour plots of all layers.



### PROTEL-PCB VERSION 2.0 NEW FEATURES

- Grid Size down to 0.001 inches, select 9 sizes.
- Maximum PCB dimensions 32 x 19 inches.
- Five zoom levels from 32 x 19 to 1.6 x 0.95 inches.
- Extensive Library facilities, predefined components.
- Rubber banding, move components and maintain tracks.
- Bill of Quantities, produced as text file.
- Area fill command for heavy tracks and ground plains.
- Track breaking, deletion and stretching capabilities.
- Seven text sizes can be rotated or mirrored.
- Four track widths 15, 30, 50 and 100 mils.
- Four sizes of edge connector.
- Six pad sizes.
- Two DIP pads
- Gerber plotter support.
- Adjustable plot starting point.

Demonstration Pack—send \$20.00 and receive a demonstration pack and instructions.

Version 1.0 owners can obtain Version 2.0 for \$50.00 plus tax.

Purchase the full program for \$890.00 plus tax if applicable plus \$10.00 freight.

### WRITTEN FOR DESIGNERS OF PCBs

**HST Industries Pty. Ltd.**  
**445 Macquarie Street, Hobart 7000**

G.P.O. Box 536F, Hobart 7001.  
Telex 58260, Telephone (002) 34 8499  
Cable Lightning Hobart

\*Registered Trade name of IBM



## EMONA INSTRUMENTS

A division of Emona Enterprises Pty Ltd

1st Floor  
720 George Street  
Sydney, 2000. Phone: (02) 212 4599



# EA marketplace EA marketplace

## ADVERTISING RATES FOR THIS PAGE

SMALL ADS: The minimum acceptable size of 2 centimetres x one column costs only \$40. Other sizes up to a maximum of 10 centimetres are rated at \$20 a centimetre. CLASSIFIEDS: \$4 for 40 letters. Just count the letters divide by 40 and multiply by \$4, ROUND UP TO NEAREST WHOLE NUMBER. CLOSING DATE: Ads may be accepted up to the 18th of the month two months prior to issue date. PAYMENT: Please enclose payment with your advertisement. Address your letter to THE ADVERTISING MANAGER, ELECTRONICS AUSTRALIA, PO BOX 227, WATERLOO, NSW 2017.

### FOR SALE

#### AMIDON FERROMAGNETIC CORES:

Large range for all receiver and transmitter applications. For data and price list and 105X220 SASE to: R.J. & U.S. Imports, P.O. Box 157, Mortdale, N.S.W. 2223. Closed for business during July. N.S.W.: Geoff Wood Electronics, A.C.T.: Electronic Components, Fyshwick Plaza. Vic.: Truscott Electronics, Croydon. W.A.: Willis Trading Co, Perth.

#### IBM COMPATABLE TURBO:

Mother Boards 4.7 & 6.7 MHz can replace genuine IBM boards \$350. Earom Electronics, 12 Florence St, Burwood, 3125. (03) 288-3835.

**SOFTWARE:** Over 900 Vol's public domain software for IBM and CPM systems. Free catalogues. Earom Electronics, 12 Florence St, Burwood 3125. (03) 288-3835.

**EX-ABC AUDIO TAPES:** 1/4" wide on 10 1/2" Standard metal spool \$6.85 Robust metal spool \$7.85. 7" spool \$2.25. 5" spool \$1.25. Post extra. Also in stock 1/2", 1" and 2" tapes. Waltham Dan, 96 Oxford St., Darlinghurst, Sydney. Phone (02) 331-3360.

**NEW RADIO VALVES:** For entertainment or industrial use. Waltham Dan, 96 Oxford St., Darlinghurst, Sydney. Phone (02) 331-3360.

**PCB-SERVICE:** Single sided 10c, double sided 13c per cm<sup>2</sup>, drilling 4c per hole (plus C.O.D.). Send artworks on film or paper to Dunas Electronics, 23 Victoria Street, Burwood, NSW. Tel: (02) 747-5449.

#### PRINTED CIRCUIT BOARDS

Minimum postage & packaging on all EA & ETI Project PCBs.

Catalogue 1976-85 (inc components) \$1.50. PCBs made to order — 48 hr prototype service. Bankcard/Mastercard.

#### Acetronics PCBs

112 Robertson Rd, Bass Hill 2197  
(02) 645 1241

#### A NEW CONCEPT FOR LOW VOLTAGE PROJECTS

**COPPER FOIL TAPE:** thin pure copper tape backed by special hi-tack adhesive. Current carrying capacity, 5 amps, FULLY TESTED at 24V 5A. Not recommended for mains voltage.

4mm...RRP \$8.03 6mm...RRP \$9.84 33 metre rolls  
**GIFFORD PRODUCTIONS**  
PO Box 62, St Kilda, Vic 3182. (02) 534 3462

**LOGIC PROBE:** 4 LED displays Logic '1' or '0', pulse, over voltage and minus voltage. Minimum detectable pulse width 10 ns and up to 50 MHz. Pulse memory capability. CMOS or TTL level selection. Model UT-1000 Price: \$28.50 P+P \$1.50 Tech Impex P.O. Box 533, Malvern, Vic. 3144.

**LOGIC PULSER:** Heavy 100mA current with low duty cycle output. Automatic pulse width, polarity, amplitude setting. External synchronization capability. An additional TTL compatible output terminal. Model UT-1000 Price: \$33.50 P+P \$1.50. Tech Impex P.O. Box 533, Malvern, Vic. 3144.

**POWER SUPPLIES:** Ex computer, open construction with fan & mains filter. 110/240V in 20V/2.5A, 5V/6A, 20V/150mA, thermal-current and over voltage protection, including circuit diagram \$35. Melbourne (03) 233-0376.

**TANBERG TAPE RECORDER:** Mod. 1200 and 4000 parts, Anadex Printer Mod. 8000 and 9500 parts, list of parts available, also Siemens 2000 16mm projector parts. Ring (02) 398-5637 A.H.

### WANTED

**MICROPHONES:** Ribbon and M.C. early broadcast and P.A. type. Any transcription programmes and commercials. Interested in anything relevant to early radio transmission. Collector. Perth (09) 279-1234. 85 Parker Street, Bassendean, WA 6054.

## One Stop Electronic Shop

Japanese Data Books for TRS, ICS, OPAMP, etc.

Power supply, cards & keyb'd, for IBMPC/XT COMP. Computer.

Toroidal Transformers

15-625VA/UP to 20A.

Custom made computer cables.

**AEM MODEM KIT \$150**

Hi-Com Unitronics

7 President Lane Caringbah

N.S.W. 2229 Ph. 02-5247878

### BUSINESS FOR SALE

#### TV & VIDEO SERVICE & TV RENTAL

A thriving, long established business in bustling Wagga Wagga, N.S.W. A rare opportunity to walk into a very busy & extremely well equipped business with exciting potential for growth. Owner retiring from business. All details & descriptive video on request. Price \$39,500. Phone (069) 215-463 Mornings. Phone (069) 223-601 Evenings.

## ARE YOU BUILDING AN EA KIT?

If you have purchased an EA kit you may not have all the info you need to build it and get it going properly. Kit suppliers often do not include all the information published on a particular project. If you want to be sure of having all the info on a kit, you need to go to the original source: *Electronics Australia*. We can supply photostat copies of any article we have published for a fee of \$4, including postage. If the article was spread over more than one issue, the charge is \$6.

Write to: The Assistant Editor,  
"Electronics Australia"  
PO Box 227,  
Waterloo, NSW, 2017

## GENERATE ELECTRICITY FROM THE SUN

ARCO PV Panels (B Class)  
40,42,47 and 53 Watts 12V.  
panels in stock

**\$7.50 per watt**

Power for pumping, lighting and refrigeration

**ELANTE PTY. LTD.**  
382 Canterbury Rd.,  
Surrey Hills, Vic. 3127  
Ph: (03) 836 9966

## R.C.S. RADIO PTY. LTD.

Established 1933

IS THE ONLY COMPANY

WHICH MANUFACTURES AND

SELLS EVERY PCB & FRONT PANEL

published in EA and ETI

**651 Forest Road Bexley 2207 AUSTRALIA**

RING (02) 587 3491 FOR INSTANT PRICES  
24 HOUR TURNAROUND SERVICE



# 50 and 25 years ago...

"Electronics Australia" is one of the longest running technical publications in the world. We started as "Wireless Weekly" in August 1922 and became "Radio and Hobbies in Australia" in April 1939. The title was changed to "Radio, Television and Hobbies" in February 1955 and finally, to "Electronics Australia" in April 1965. Below we feature some items from past issues.

## RADIO, TELEVISION and HOBBIES

May 1961

**London TV tower:** plans to erect the tallest building in London, a 500ft tower to carry micro-wave radio and television links, were announced by the British Postmaster General.

The project, estimated to cost about 1½ million pounds sterling, was designed to obviate the risk of obstruction to television and public telephone services from existing buildings or those planned.

Believing that the new tower would add to London's amenities the Post Office was providing a public observation platform at 450ft. It was hoped that the tower would be completed by 1964.

## Wireless Weekly

May 1936

**Adults only:** the French radio authorities, so it is said, have decided to classify programmes, very much in the manner of the Australian film censor — "for adults only", etc. When the announcer begins an introduction to a program with "Mesdames, Messieurs", the kids must go to bed; when he begins with "Mesdames, Mesdemoiselles, Messieurs", they can stay up; the inclusion of "Mesdemoiselles", ie blushing maidens, means the programmes are in the "U" class for universal distribution.

**Cable TV:** a new telephone-television service between Berlin and Leipzig uses over 100 miles of co-axial cable, and

**Non-integrated circuit:** a new technique for "shrinking" missile components — to reduce weight and size — is demonstrated by this thumbnail size package which contains a complete amplifier circuit. The amplifier, developed by the General Dynamics Corporation, is part of the infra-red guidance systems of a missile. It is a solid block of plastic containing transistors, resistors and capacitors. It is probably no larger than three eighths of an inch cube.

**One handed screwdriver:** a new British screwdriver called the "Slotgrip", described in the BBC program "New Ideas", is likely to save mechanics and handymen a great deal of time.

The new tool costs only a few shillings to produce and contains down its spine a piece of metal which automatically twists round when you press down its head.

scanning of 180 lines definition at 25 frames a second. Each city has two public telephone-television offices, at which three minutes' talk costs 3.5 marks.

**Short-wave highlights:** these were the high spots in the short wave band last night according to our observer: the staccato voice of the Italian dictator, Mussolini, raised high in vehement speech; the voices of passengers in the huge air liner, the Hindenburg, thousands of feet above the stormy Atlantic; last but not least, the voice of our very own versatile editor A. G. Hull sending his greetings from New York.

**Cordless guitar:** (with a photograph) Ray Olsen, leader of the Blue Five guitar combination, with his radio electric guitar. The notes on each of its six strings are picked up electrically and fed through separate amplifiers in the portable unit. This enables the tone and volume to be controlled as desired, making the instrument especially suitable for orchestral work.

Ian J. Truscott's

## ELECTRONIC WORLD

### MORE & MORE

People are discovering us each week. Both the home enthusiast through to the small manufacturer.

### COMPONENTS • TOOLS • KITS

In any quantity, buy one, or one thousand, we're happy to oblige

### SCHOOLS • CLUBS ETC.

Inquire about our bulk discount deals

Save yourself a trip to the city — come to

**30 LACEY STREET  
CROYDON**

OR PHONE

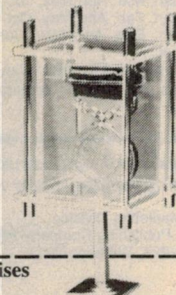
**(03) 723 3860/  
723 3094**

Mail orders welcome.

### Choosing the right display for your coins, medals or stamps is easy when you buy a presentation PYX.

This innovative small display cabinet is handcrafted to give your coin, medal or stamp an appropriate resting place. Despite it being totally enclosed you'll have a global view. The content is dustproof, yet you may take it apart anytime.

It comes in a highly polished brass or in 24 carat pure gold plate. There are many models available for you. Send for your obligation free brochure NOW.  
**Prices from \$39.60**



To: Elja Enterprises  
P.O. Box 667  
Cheltenham 3192  
or Tel: (03) 583 8274

Main Interest is

☐ Coins ☐ Medals ☐ Stamps

Please forward an obligation free brochure to:

Name .....

Address .....

.....Postcode.....



Protect your copies of

# Electronics Australia

in these binders or holders



## MAGAZINE BINDERS \$7.50

Ready to use binders with easy, clip-in fastener, covered in soft, decorator brown vinyl. Holds 12 issues of electronics Australia.

## MAGAZINE HOLDERS \$7.00

Big, easy to assemble holders, covered in soft, decorator brown vinyl. Holds 12 issues (at least) of Electronics Australia.

Postage and packaging additional:  
Please refer to reply card for charges.

**SAVE WITH SIX**

6 Holders — only **\$37.50**  
6 Binders — only **\$39.95**

Order today —

Simply return The Freepost reply card to:

Tel: (02) 663-9999.

Tlx: AA74488

The Federal Publishing Company,  
PO Box 227, Waterloo, NSW 2017.

## Electronics Australia Reader Service

"Electronics Australia" provides the following services:

**BACK ISSUES:** Available until stocks are depleted. Price \$4 including postage and handling. When back copies are exhausted, reprints of articles may be obtained for the same cost. If the issue you require is not shown on the list below, please nominate the article you would like photocopied and the issue in which it appeared. Send cheque, money order or credit card number (American Express, Bankcard, Master Card), name and address to Federal Publishing Company, PO Box 227, Waterloo 2017.

### AVAILABLE BACK ISSUES:

1981: Jun, Jul, Nov.

1982: May, Oct.

1983: Jan, Mar, Apr, May, Jul, Aug, Nov, Dec.

1984: Jan, Feb, Apr, May, Oct, Nov.

1985: Jan, Feb, Apr, May, Jun, Jul, Aug, Sep, Oct, Nov, Dec.

**PC BOARD PATTERNS:** High contrast, actual size transparencies: \$3, including postage. Please specify positive or negative.

**PROJECT QUERIES:** Members of our technical staff are not normally available to discuss individual projects, either in person at our office, or by telephone.

**REPLIES BY POST:** Limited to advice concerning projects published within the last three years. Charge \$3. We cannot provide lengthy answers, undertake special research, or discuss design changes. Nor can we provide any information on commercial equipment.

**OTHER QUERIES:** Technical queries outside the scope of "Replies by Post" or submitted without fee may be answered in the "Information Centre" pages, at the discretion of the Editor.

**COMPONENTS:** We do not sell electronic components. Prices and specifications should be sought from advertisers or agents.

**REMITTANCES:** Must be negotiable in Australia and made payable to "Electronics Australia". Where the exact charge may be in doubt, we recommend submitting an open cheque endorsed with a suitable limitation.

**ADDRESS:** All requests to the Assistant Editor, "Electronics Australia", Box 227, Waterloo, 2017.

Total price of magazines/photocopies,  
including postage and handling.

No off issues reg ..... x \$4 = \$.....

Direct Marketing Division,  
Federal Publishing Company Pty Ltd,  
PO Box 227, Waterloo 2017.

Cheque\*/Money Order ☐ Please tick box to indicate  
method of payment:

\*Please make payable to the Federal Publishing Company Pty Ltd.

Mastercard ☐ American Express ☐ Bankcard ☐ Tick ☒

Card Expiry Date .....

--	--	--	--	--	--	--	--	--	--

Credit Card No.

Signature .....  
(Unsigned Orders cannot be accepted)

NAME: .....

ADDRESS: .....

POSTCODE .....

## ADVERTISING INDEX

Acetronics	112
Altronics	16,17,62
Amtex	105
Audiocraft	107
Audio Engineers	31
Australian School Electronics	98
Bose Australia	14
Cashmore Enterprises	34
Chapman L.E.	109
Conference Technology	OBC
Control Data	60
CQ Electronics	112
Creative Electronics	70,71
David Reid	74
Dick Smith Electronics	43,44,45,46,47,48,49,50
DNA Communications	107
Eagle Electronics	103
Eastern Communication	101
Elante	112
Elija Enterprises	113
Elmeasco	35,1FC
Emona	111
Emtronics	31
Federal Publishing	80,81,IBC
Force	106
GEC	15
Geoff Wood	67
Gifford Productions	112
HFT Industries	111
Hi-Com Unitronics	112
Icom	107
ICS	card insert
IEI	33
Jaycar	36,37,86
Odyi	77
Pacific	102
Patlas	95
Philips Elcoma	79
RCS Design	82
RCS Radio	112
Ritronics	24,25,56,57,96,97
Scan Audio	21
Shredall	113
Siemens	9
Stotts	69
Visionhire	99
VSI	23,



# Look Great! Be Alive! Feel years younger than you really are!

**YOU CAN  
SHARE IN  
PRIZES WORTH  
OVER \$30,000**

**ISN'T IT TIME YOU REALLY DID  
SOMETHING ABOUT YOUR HEALTH?**



## Do it now!

Learn to be healthier and live longer by subscribing to the magazine that will bring you as close as you'll get to the proverbial fountain of youth! Prevention Magazine is for people, like you, who want expert guidance towards vitality and happiness through simply feeling fit and well. It's not for "nut and berry" hippies, it's for normal people like you who have a sensible approach to diet and fitness.

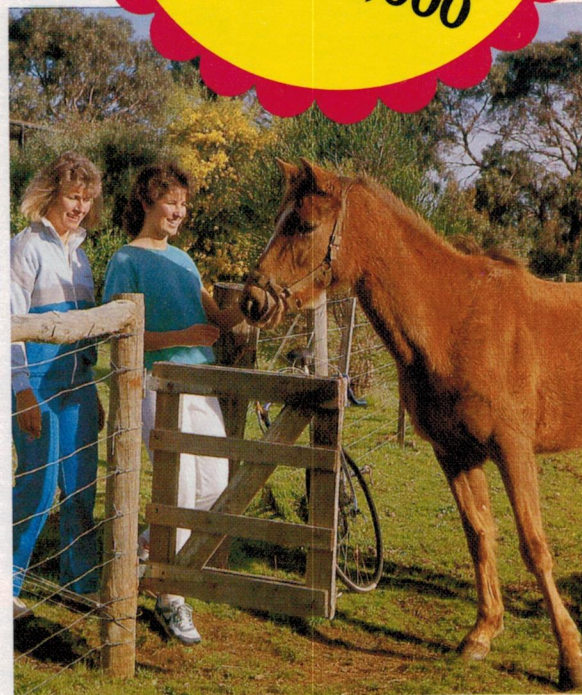
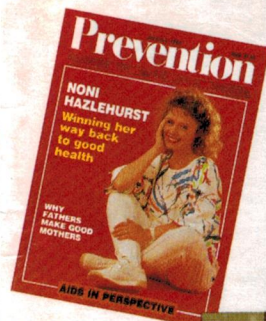
You'll find Prevention is jam-packed with really interesting and beneficial features and ideas. You'll read articles that are entertaining and full of worthwhile facts and information.

## OVER 100 REASONS FOR YOU TO READ PREVENTION MAGAZINE

Every issue of Prevention gives you over 100 pages of ways to have a better life. Articles on food will introduce you to mouth-watering dishes you'll wish you'd found out about years ago. Prevention's fitness and beauty editor will demonstrate simple and sensible ways for you to noticeably improve your physical appearance and general well-being.

## NEWS GALORE! THE NEW AND EXCITING IS ALWAYS AT YOUR FINGERTIPS!

You'll always be up-to-date on what's happening on the health front. Prevention brings you the latest in news on all health and beauty topics – as and when they happen. There are book reviews, doctor's talks, simple exercises, sensible diet programs, new product reports, new discoveries, recipes, environmental studies and many other areas that you need to know about.



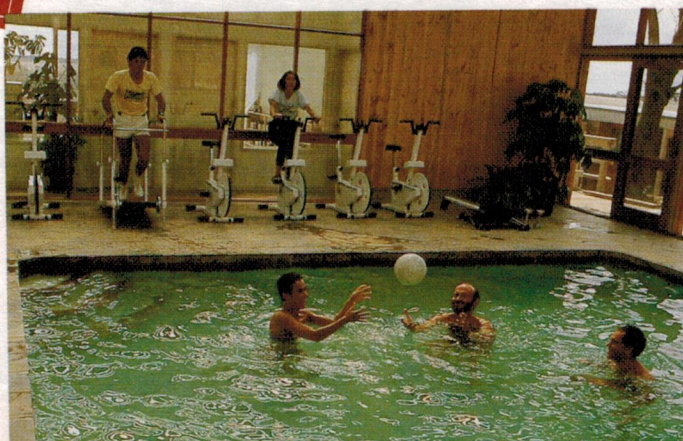
The Bellbrae holiday opportunity prize is just one of the extra special offers made to readers of Prevention.

## PRIZES AND GIFTS – YOUR EXTRA BONUS!

Health and improving your life and happiness are only part of the bonus of reading Prevention Magazine. If you buy Prevention now you will not only improve your lifestyle, you'll receive a free gift – worth over \$14.00 – just for deciding to subscribe!

**PLUS** Every new subscription received until August 31, will give the subscriber a chance to share in over \$30,000 worth of wonderful prizes – the major prize being a FREE HOLIDAY, for one week, for the next ten years, to one of Australia's premier health resorts – **BELLBRAE'S HEALTH FARM**

Do yourself, and your body the favour of your life – buy Prevention magazine. Buy it! Read it! Subscribe to it! Prevention will be the best investment you will ever make for your future! And when you've bought it, read it, and subscribed to it, you'll be in the running for a great prize that will benefit you for the next 10 years. You'll receive your free gift worth over \$14.00, but most importantly, you'll feel great, you'll look better than you ever have before and people will think you are years younger than you really are!



Just one of the many varied activities you will enjoy on your FREE week's holiday every year!

# Prevention

NSW Permit No. TC86/530 issued under The Lotteries and ART Unions Act, 1901. VIC Raffles and Bingo Permits Board. Permit No; 86/269 issued on 13/03/86. ACT Permit No. TP 86/163 issued under Lotteries Ordinance 1964.

This exciting prize draw is also open to all subscribers who renew before the closing date.  
If the prize is not claimed within 12 months, a second draw will be run.



Introducing

# ***the handlers***

UNIDIRECTIONAL DYNAMIC MICROPHONES

*La linea Italiana*



**paso**  
SOUND PRODUCTS



For information & literature contact  
Conference Technology PTY LTD  
100 Gladstone St.  
Sth Melbourne, 3205  
Ph: (03) 690 9988